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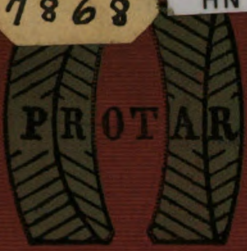

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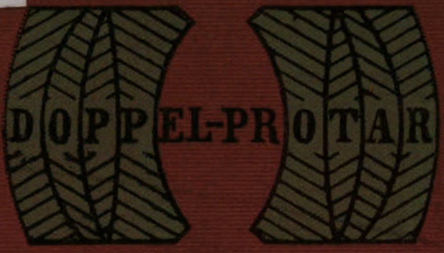

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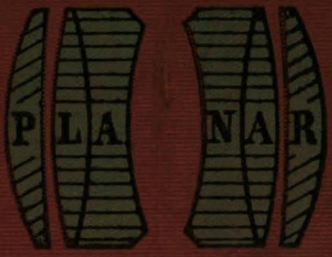

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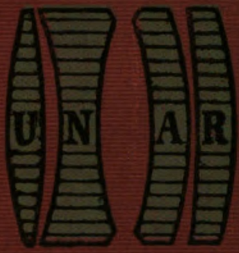

1900

CARL ZEISS

OPTISCHE WERKSTAETTE

Edition for the U.S.A.

JENA

Photographic Department

PHOTOGRAPHIC OBJECTIVES
AND
PHOTO-OPTICAL AUXILIARY APPLIANCES

1901

KG 7868

CARL ZEISS

OPTISCHE WERKSTAETTE

JENA

Berlin NW.
Dorotheenstrasse 29 II.

London W.
29, Margaret Str., Regent Str.

Section for Photography.

PHOTOGRAPHIC OBJECTIVES
AND
PHOTO-OPTICAL AUXILIARY APPLIANCES.

NEW YORK,
104 EAST 23D ST.
125 WEST 42D ST.
650 MADISON AVE.

MINNEAPOLIS,
604 NICOLLET AVE.

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360 ST. PETER ST.

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E. B. Meyrowitz
Optician,
Sole Agent for
Carl Zeiss Photo Lenses
and Agent for Palmos Cameras,
104 East 23d Street, - - New York.

P. 22. V. 1901. 1000 a.

KG 7868

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The following firms have acquired the right of manufacturing our **Photographic Objectives** *as specified in this Catalogue:*

Bausch & Lomb Optical Co., *Rochester, N. Y., and New York City, U.S.A.;*

Karl Fritsch, *formerly* **Prokesch,** *33 Gumpendorferstr., Vienna;*

F. Koristka, *2 Via G. Revere, Milan;*

E. Krauss, *21 & 23 Rue Albouy, Paris;*

Ross Ltd., *111 New Bond Street, London W.*

These firms are supplied by us with all the data required for the manufacture of these lenses as made by ourselves (curvatures, thicknesses and distances of lenses and description of the glasses used), and are thus placed in a position enabling them to make ZEISS-Objectives of the same quality as ourselves.

In addition to this detailed Catalogue

of Photographic Objectives and Photo-optical Auxiliary Appliances the following publications relating to **Photography** may be had gratis and post free on application:

Price-list of Photographic Objectives and Instantaneous Shutters.

Short Suggestions and Tables for the ***selection*** *of our* ***Photographic Objectives*** *for Amateur and Professional purposes.*

A monograph on the Nature and Application of ***Tele-photographic Objectives,*** *by Dr. P. RUDOLPH, May 1896.*

Tables of Diameters of Stops *applicable to our Photographic Objectives at given relative apertures.*

The following Catalogues may also be had in English, French, or German:

Catalogue of ***Microscopes*** *and* ***Microscopical Accessories.***

Catalogue relating specially to ***Projection*** *and* ***Photo-micrographic Appliances.***

Catalogue of ***Optical Measuring Instruments*** *for Physical, Chemical and Industrial Purposes (German and English only).*

Prospectus relating to Portable ***Zeiss-Field-Glasses*** *and* ***Stereo-Telescopes.***

Prospectus relating to ***Binocular*** *and* ***Monocular Tripod Telescopes.***

Prospectus relating to our ***Stereoscopic Range-Finder.***

Price-list of ***Astronomical Objectives*** *and* ***Astronomical Instruments.***

◆

The Photographic Department

of our Works under the scientific superintendence of Dr. P. RUDOLPH has been considerably extended in the course of the last few years. On comparing this new edition of our Catalogue of Photographic Objectives and Photo-optical Auxiliary Appliances with the now obsolete edition of 1899 (last English and French Editions dated 1897), it will be noted that, besides many textual alterations, the list of articles has expanded in a remarkable manner. **Thee haver not, however, been any important alterations in the prices.**

Our prices are strictly Net Cash and do not include cost of packing and carriage from Jena. Payment may be made by Cash, Cheques or short negotiable English, French or German Bills of Exchange.

Terms: Nett cash, delivered duty paid New York.

Purchasers who have no regular account with us are requested to send cash with order.

Goods are forwarded, value declared, at the risk and cost of the consignee. In the absence of special instructions, goods ordered from abroad are despatched by the best and most convenient route, every precaution being taken to ensure safe and prompt delivery.

In telegraphic orders it is sufficient to quote the **code-words** given in the tables relating to the various articles.

Jena, March 1901.

Carl Zeiss,
Optische Werkstaette.

Telegraphic Address: ***Zeisswerk, Jena.***

Branch Establishments for the purpose of sale and minor repairs:

CARL ZEISS, 29^{II} Dorotheenstrasse, **Berlin NW.**,

CARL ZEISS, 29 Margaret Street, Regent Street **London W.**

(Telegraphic Address: ***Diactinic, London.****)*

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Our Illustrations

demonstrate the working qualities and scope of the objectives to the description of which they are appended.

Preface.

Ten years have passed since the appearance of our first Catalogue of Photographic Appliances in 1891. A comparison of that catalogue in its modest form with the present edition will demonstrate at a glance what a very decided advance in all branches of photography has taken place in that short space of time. Not only has photography gained a dominant position in the ever-expanding field of reproduction, but it has also become the favourite pastime of all classes of society and an important auxiliary to art and scientific research.

There can be no doubt that our objectives have given considerable impulse to this development, because they at last furnished a solution of the problem, which had been a stumbling block ever since photography was first invented, viz. the problem of how to combine rapidity with anastigmatic flatness of field.

The story of the development of our industry, from the wide-angle Anastigmats of 1890 to the birth of the Planar in 1897, is related in a work by Dr. M. von ROHR of Jena, which was published in 1899 under the title of "Theorie und Geschichte des photographischen Objectivs"; the year 1900 witnessed the advent of our latest novelty in the field of photographic optics, viz. the **Unar.**

In this space of little more than ten years the combined supply to all parts of the world by ourselves and our license-holders has reached a round total of

100 000 Anastigmatic Objectives

and this fact ought to be sufficient proof of the high estimation in which our productions are held. We may be allowed to advance the opinion that the universal confidence extended to us is in a great measure due to our exact methods of execution, which enable us to give an absolute guarantee of the equally perfect condition of each instrument of any given class. Hence, every one of our customers has the positive assurance of being supplied by us exclusively with goods of the very highest grade.

In order that the name itself should suggest the characteristic features of our anastigmatic objectives, we adopted the descriptive designation of "Anastigmat", a word which at the time in question was seldom used. But other makers soon applied the same name to objectives which neither in external appearance nor in their nature could bear comparison with our lenses, and this abuse created a dangerous state of confusion. To obviate the difficulty we decided in the course of the year 1900 to drop the name "Anastigmat" and to adopt instead the registered name of **"Protar".** Following up the same principle, we also had the trade description for the new constructions already mentioned — the **"Planar"** and the **"Unar"** — registered as our exclusive property, so that these names cannot in future be applied to any but our own objectives.

The **"Unar",** described in a supplement (published on April 1, 1900) to the 1899 edition of our catalogue, is remarkable for rapidity and simplicity of construction. On account of its universality of application it is eminently adapted for hand cameras and surpasses in excellence all objectives previously applied to this purpose.

In addition to the notice of this new production we would make the important announcement that by the employment of new kinds of glasses from the Glass Works of Messrs. SCHOTT & GENOSSEN of JENA, we have been enabled to construct anastigmatically well corrected objectives with reduced secondary spectrum. We flatter ourselves that we have therely rendered an important service to the reproduction branch of photography, and this opinion has received confirmation from the large number of letters of commendation received by us.

In conclusion, having received many urgent solicitations for **light objective mounts,** we have decided to supply our objectives in future, if specially so ordered, in mounts of a light alloy of aluminium. This metal, if not subjected to careless usage, offers a sufficient guarantee of durability, it diminishes the weight of an objective considerably, and will, no doubt, gain special favour as a material for mounting the **objectives of hand cameras.**

Jena, March 1901.

Carl Zeiss,
Section for Photography.

Photographic Lenses.

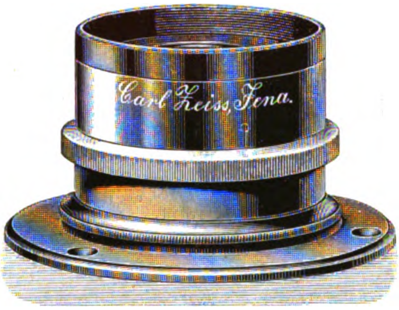
Objective Mounts.

The whole of the photographic objectives specified in this catalogue are kept in stock in our Standard mounts. These mounts may be recommended for their special adaptability for universal purposes and embrace the following patterns:

The Standard Mount

with

Iris-diaphragm,

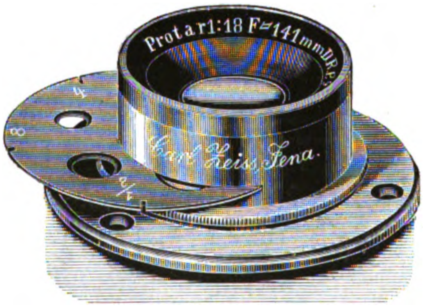


or, for the smaller sizes of the wide — angle Objective Protar $^1/_9$, Series III^a, and Protar $^1/_{18}$, series V,

The Standard Mount

with

Revolving-Diaphragm.

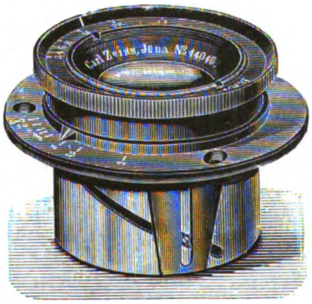


We also keep in stock, so for as business considerations allow, the smaller objectives of the rapid series I^a, I^b, II^a, III^a and VII^a for hand cameras without adjustable extension, fitted in our

Special Mount A

with

Iris-diaphragm and
Focusing Attachment.



For bellows cameras, which when folded form a compact case and possess adjustable extensions, we recommend our rapid objectives in

Special Mount B

with

Iris-diaphragm.

In this form the mount is fixed to the flange by which it is fastened to the camera front.

With the smaller objectives the iris-diaphragms are made with **vulcanite leaves,** because the employment of this material obviates the inevitable tendency of metallic laminae to become bright or rusty. When, however, the lenses are required for **projection** with electric light or sunlight, vulcanite leaves would be too vulnerable, and it is therefore advisable in such cases to order an objective with **iris-diaphragm made of steel laminae.** These we supply on short notice and without extra charge. Our iris-diaphragm and the method of fitting it to the tube portion of the mount are protected by patent in several countries, in Germany under Patent No. 84 996.

The Standard Mount with **revolving diaphragm** shown in the illustration on page 11 is specially suitable for **stereoscopic pairs.** In this combination it is essential that both objectives should be stopped exactly alike, and this result is, as a rule, attained with greater certainty by using revolving rather than iris-diaphragms.

Besides **brass,** we also use an **alloy of aluminium** for objective mounts. On account of the considerable reduction in weight as compared to brass, we specially recommend aluminium alloy to intending purchasers of the smaller objectives for hand cameras fitted in Special Mount *A*. With reasonable care against improper usage the durability of our mounts of aluminium alloy is fully assured.

In addition to the mounts described above we are also prepared, upon receipt of special and definite instructions, to supply our **objectives in any design of mount desired.** In such cases it will be necessary to send us exact specifications or, better still, working models. A charge will be made for any extra work in carrying out such orders.

Table of Standard Mounts with Iris-Diaphragm.

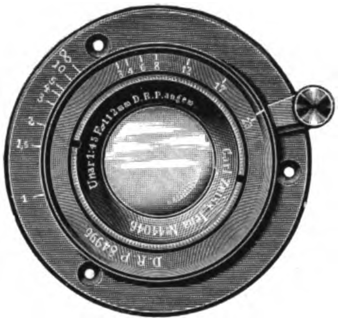
Distinctive number of Mount	External Diameter of the Mount (Sunshade)		Length of the Mount		Diameter of the largest stop		Adapted for Ojective Series							Price incl. Re-mounting lenses
							I^a	I^b	II^a	III^a	V	VII	VII^a	
	mm	in.	mm	in.	mm	in.	No.	No.	No.	No.	No.	No.	No.	$
0	19.3	$^{3}/_{4}$	16	$^{5}/_{8}$	10	$^{3}/_{8}$	1, 2, 6	—	—	—	0, 00	0	0	7.—
I	27	$1^{1}/_{16}$	16	$^{5}/_{8}$	14	$^{9}/_{16}$	3	—	0	0	1, 2	00, 1	00, 1	7.—
II	32	$1^{1}/_{4}$	16	$^{5}/_{8}$	20	$^{13}/_{16}$	4, 7	—	1, 2	00, 1, 2	3, 4, 5, 6, 7	000 — 2	0—2, 4	7.—
III	36.8	$1^{7}/_{16}$	23	$^{7}/_{8}$	23	$^{7}/_{8}$	5, 8	3	3	3, 4	7^a, 8	3	1—5, 7	7.—
IV_1	41.8	$1^{5}/_{8}$	33	$1^{5}/_{16}$	28	$1^{1}/_{8}$	9	—	4	5	—	4	4—8, 10	9.—
IV_2	41.8	$1^{5}/_{8}$	23	$^{7}/_{8}$	28	$1^{1}/_{8}$	—	4, 5	—	—	—	—	—	9.—
V	46.9	$1^{13}/_{16}$	35	$1^{3}/_{8}$	30	$1^{3}/_{16}$	10	—	5	6	—	—	—	9.—
VI	50.9	2	40	$1^{9}/_{16}$	33	$1^{5}/_{16}$	—	—	6	—	9	5	7—11, 13	9.—
VII	56.9	$2^{1}/_{4}$	35	$1^{3}/_{8}$	40	$1^{9}/_{16}$	—	6	—	7	—	—	—	10.—
VIII	56.9	$2^{1}/_{4}$	52	$2^{1}/_{16}$	40	$1^{9}/_{16}$	11	—	—	—	—	6	7—14, 16	10.50
IX_1	63.5	$2^{1}/_{2}$	50	$1^{15}/_{16}$	44	$1^{3}/_{4}$	—	—	7	8	—	—	—	11.50
IX_2	63.5	$2^{1}/_{2}$	68	$2^{5}/_{8}$	44	$1^{3}/_{4}$	12	—	—	—	—	—	—	11.50
X_1	69	$2^{11}/_{16}$	60	$2^{3}/_{8}$	50	$1^{15}/_{16}$	—	—	—	—	10	7	15, 17, 19	12.—
X_2	69	$2^{11}/_{16}$	45	$1^{3}/_{4}$	50	$1^{15}/_{16}$	—	7	—	—	—	—	—	12.—
XI	74	$2^{7}/_{8}$	64	$2^{1}/_{2}$	52	$2^{1}/_{16}$	—	—	8	9	—	—	—	12.50
XII_1	84.5	$3^{5}/_{16}$	74	$2^{15}/_{16}$	58	$2^{5}/_{16}$	13	—	—	10	—	8	18, 20, 22	13.50
XII_2	84.5	$3^{5}/_{16}$	55	$2^{3}/_{16}$	58	$2^{5}/_{16}$	—	8	—	—	—	—	—	13.50
XIII	97.5	$3^{13}/_{16}$	86	$3^{3}/_{8}$	66	$2^{9}/_{16}$	14	—	—	—	—	9	25	17.50
XIV	106.5	$4^{3}/_{16}$	86	$3^{3}/_{8}$	72	$2^{13}/_{16}$	15	—	—	11	—	10	28	18.50
XV	115.5	$4^{9}/_{16}$	104	$4^{1}/_{8}$	83.5	$3^{1}/_{4}$	16, 17	—	—	12	—	11	30	19.50
XVII	153.5	6	146	$5^{3}/_{4}$	110	$4^{5}/_{16}$	18	—	—	—	—	—	—	24.50

Carl Zeiss, Optische Werkstaette, Jena.

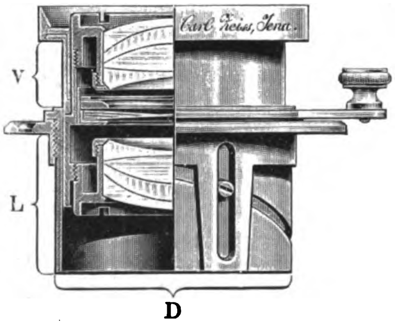
Special Mount A.

A Lens Mount with Iris-diaphragm and Focusing Attachment for Stand Cameras.

The Special Mount A is adapted for **Detective Cameras with fixed extension,** in which the instantaneous shutter is placed either directly behind the lens, or close in front of the sensitive plate. Its front is fitted with a collar for adjusting the iris-opening, and an arrangement for altering the distance between lens and sensitive plate facilitates the attainment of a sharp focus.



The first of the two illustrations appended represents this Special Mount as viewed from the front. The divisions of the scale on the inner rotating ring, viz. 24, 17, 12, 8, 6, 4, 3, refer to the iris-diaphragm, and the figures express in millimetres the various diameters of the iris-opening which may be obtained by altering the position of the index mark on the outer rotating ring. The relative apertures corresponding to these actual diameters may be ascertained from the table of stops supplied with each lens of our make. Copies of these tables may be always obtained gratis on application. The divisions of the scale on the outer ring — marked Metres 2, 3, 4, 5 to infinity — refer to the focusing appliance, which is used by turning the index by the projecting lever to the point on the scale corresponding to the distance of the object to be photographed. The infinity mark (∞) applies to very distant objects.



The second figure shows the elevation of the mount, one half being seen in section. *L* is the length of that portion of the mount which projects into the camera, *D* the external diameter of the same, and *V* the greatest possible amount of movement of the lens in relation to the sensitive plate.

The objective is, as a rule, attached to the camera front by the outer ring on which the metre scale is engraved. For this purpose the ring is provided with three screw holes. The camera extension should be so adjusted that when the mount is set to the infinity mark, a very distant object should be seen sharply on the focusing screen.

We make this Special Mount in five different sizes, the dimensions and prices of which are shown in the following table.

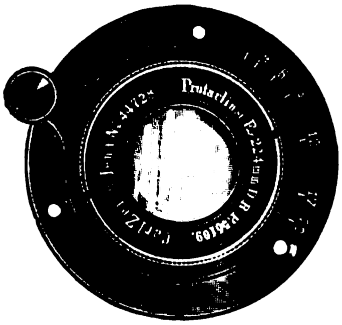
Special Mount A.

Descriptive No.	*D* External Diameter of the Mount		*L* Length of Mount		*V* Greatest movement		Largest Iris-diaphragm.		Adapted for Objective	Additional cost of Objective fitted with Special Mount *A*	Code-Word	Cost of re-mounting old objective in Special Mount *A*
	mm	in.	mm	in.	mm	in.	mm	in.	Series and No.	$		$
A II	40.5	$1^{9}/_{16}$	21	$^{13}/_{16}$	16	$^{5}/_{8}$	20	$^{3}/_{4}$	I^{a} 4, 7. II^{a} 0, 1, 2. III^{a} 00, 1, 2. VII^{a} 0—2, 4.	3.50	**Zobel**	10.50
A III	45	$1^{3}/_{4}$	25	1	20	$^{3}/_{4}$	23	$^{7}/_{8}$	I^{a}5,8. II^{a}3. III^{a}3,4. VII^{a} 1—5, 7. I^{b} 3.	3.50	**Zone**	10.50
A IV$_{1}$	50	$1^{15}/_{16}$	33.5	$1^{5}/_{16}$	25	1	28	$1^{1}/_{8}$	I^{a} 9. II^{a} 4. III^{a} 5. VII^{a} 4—8, 10.	5.50	**Zodiakus**	14.—
A IV$_{2}$	50	$1^{15}/_{16}$	23.5	$^{7}/_{8}$	13	$^{1}/_{2}$	28	$1^{1}/_{8}$	I^{b} 4 and 5.	4.50	**Zola**	13.—
A V	55	$2^{1}/_{8}$	38–43	$1^{1}/_{2}$–$1^{11}/_{16}$	30	$1^{3}/_{16}$	30	$1^{3}/_{16}$	I^{a} 10. II^{a} 5. III^{a} 6.	5.50	**Zostera**	14.—

Special Mount B.

Objective Mount fitted with Iris-diaphragm and Fixed Flange.

When it is desired to fit the objective to a camera with adjustable bellows extension (one provided with a focal plane shutter, and which, when closed, takes the shape of a compact case) it is an advantage to be able to fix the objective so that the greater part of it may project into the bellows, the depth of the case being thus reduced to the smallest possible dimensions.



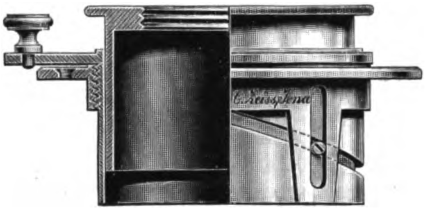
In this case the mount will externally resemble the Special Mount *A*, but **without** focusing attachment. The marginal illustration gives a front view of this Special Mount *B*, from which it will be seen that the iris-diaphragm is adjusted by means of the lever, the figures 24, 17, 12, 8, 6, 4, 3, indicating the diameter of the iris-openings in millimetres.

Special Mount B. Descriptive No.	External Diameter of the Mount mm	in.	Average length of part of Mount projecting into the Camera mm	in.	Largest Iris-diaphragm mm	in.	Adapted for Objective Series and No.	Code-Word.
B II	36	$1^3/_8$	16	$^5/_8$	20	$^3/_4$	I^a 4, 7. II^a 0, 1, 2. III^a 00, 1, 2. VII^a 0 — 2, 4.	**Zuccaro**
B III	41	$1^5/_8$	23	$^7/_8$	23	$^7/_8$	I^a 5, 8. II^a 3. III^a 3, 4. VII^a 1 — 5, 7. I^b 3.	**Zujan**
B IV_1	46	$1^{13}/_{16}$	33	$1^1/_4$	28	$1^1/_8$	I^a 9. II^a 4. III^a 5. VII^a 4 — 8, 10.	**Zulu**
B IV_2	46	$1^{13}/_{16}$	22	$^7/_8$	28	$1^1/_8$	I^b 4 and 5.	**Zupitza**
B V	51.4	2	34	$1^5/_{16}$	30	$1^3/_{16}$	I^a 10. II^a 5. III^a 6.	**Zurita**

Objectives in Special Mounts *B* are supplied at the same price as those in Standard Mounts.

Non-rotating Focusing Collar.

This objective non-rotating focusing collar is intended for cameras having fixed extension, and its application is therefore generally restricted to short-focus lenses in Standard Mounts.



Focusing Collar No. 1
(about $^3/_4$ full size).

The collar is attached to the front of the camera with small screws, and the objective itself, in Standard Mount, is screwed into the thread of the collar. The lever situated on the periphery of the collar serves for the purpose of focusing the object. In this operation neither the objective nor the shutter, or iris if fitted, rotate.

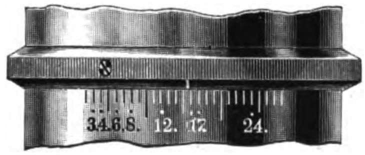
The collar is supplied with or without focusing scale, at the option of the purchaser.

No.	Outside Diameter of Tube mm	in.	Length of Collar mm	in.	Total Movement mm	in.	Adapted for Mount No.	Brass Focusing Collar without scale Price $	Code-Word	with scale Price $	Code-Word	No.
1	50	$1^{15}/_{16}$	22	$^7/_8$	16	$^5/_8$	III	**4.50**	**Stater**	**5.50**	**Stentor**	1
2	55	$2^1/_8$	23.5	$^7/_8$	16	$^5/_8$	IV	**4.50**	**Stella**	**5.50**	**Stola**	2

Graduation of the Stops of the Standard Mounts fitted with Iris-diaphragms according to the diameter expressed in millimetres.

Up to a recent period the various obtainable apertures of the iris-diaphragm were regulated with the aid of a collar divided in terms of the relative apertures (expressed in fractional foci) and corresponding to the stop used.

When, however, it became necessary to construct our tube mounts so that they should be universally adaptable for objectives of series VII^a and other combinations of objectives having similar dimensions but dissimilar foci, we had to depart from this system of graduation and replace it by one adapted to meet the change in focal length which ensues on the use of each single component lens as a separate objective. In order to satisfy these requirements in a simple and efficient manner we have engraved on our mounts a scale, each division of which corresponds to a change of one millimetre in the diameter of the iris-diaphragm. In other words, we have adopted a regular **millimetric scale** to indicate the actual diameter of the iris opening. On this scale the numbers divisible by 5 and 10 are distinguished by longer strokes, and figures are only appended to the lines marking 3, 4, 6, 8, 12, 17 and 24 millimetres. We have given prominence to this series of numbers since, **the squares of two consecutive numbers being related as 1 : 2, the exposures corresponding to these stops must be as 2 : 1, no matter what the focal length of the objective may be.** The marginal illustration shows the scale engraved on the tube of the mount.



Millimetric Iris divisions on Standard Mount IV.

(The index shows that 15.6 mm is the diameter of the iris-aperture in use.)

As a means of assisting in quickly determining the relative apertures at which the lens is working, or in fixing any required relative aperture for a given objective, we have published tables, by the use of which the diameter of the stops, expressed in millimetres, may be compared with the relative aperture of any particular objective. These tables, worked out both in accordance with the U. S. of the *Photographic Society of Great Britain* and the system introduced by Dr. P. RUDOLPH, are given below, and copies of them may also be obtained separately.

The relative aperture corresponding to a given lens stop. By the relative aperture of a stop — in relation to an objective — we understand the ratio of the diameter D of the effective pencil of parallel rays entering the lens through a given stop to the equivalent focal length F of the objective, viz. $D:F$.

The methods to be adopted to accurately determine D may be found in any good text-book of photographic optics. But if it be only a question of obtaining an approximate result, it is sufficient to measure the diameter of the circle of light seen when looking from the front through the objective having the given stop. D may therefore also be called the apparent diameter of the aperture of the stop. This apparent diameter D is, with all objectives of the doublet type, always greater than the actual diameter d of the stop. The amount of this difference varies widely according to the type of the lens and the largest relative aperture at which it may work. It is, therefore, quite an erroneous plan, though still largely adhered to, to measure and name the stops in terms of the ratio $d:F$, since, by this method, any accurate comparison of objectives belonging to different series and of different types corresponding to a given stop is impossible.

The system of stops of the Photographic Society of Great Britain (U. S. Nos). According to this system the relative apertures

$$\frac{D}{F} = 1 : \frac{F}{D} \text{ are graduated after the following series:}$$

$$^1/_{64};\ ^1/_{45\cdot2},\ ^1/_{32},\ ^1/_{22\cdot6},\ ^1/_{16},\ ^1/_{11\cdot3},\ ^1/_{8},\ ^1/_{5\cdot6},\ ^1/_{4}\ \ldots\ldots = 1 : \lambda.$$

In this, as in all other existing systems, the squares of two successive numbers are in the ratio of 1 : 2, and since the squares of the apertures are directly related to the corresponding rapidities and inversely as the periods of exposure, this series possesses the elements of convenience, inasmuch as

> any one stop causes the lens to work with double the rapidity of the preceding (smaller) and half the rapidity of the succeeding (larger) stop,

or, in other words,

> any one stop demands half the exposure required by the preceding (smaller) and double the exposure required by the succeeding (larger) stop.

For convenience in the use of this series of stops the relative apertures are distinguished by integral numbers which are related to each other exactly as the corresponding relative exposures *(E)*. These numbers have been chosen in such a manner that **the relative aperture 1:4 has been taken as the standard unit of aperture.** We thus obtain the following system:

Relative aperture of the stop $1 : \lambda$	**Relative exposure** (Corresponding No. of stop) U. S. No. $E = \left(\frac{\lambda}{4}\right)^2$	**Relative aperture** of the stop $1 : \lambda$	**Relative exposure** (Corresponding No. of stop) U. S. No. $E = \left(\frac{\lambda}{4}\right)^2$
1 : 64	256	1 : 11.3	8
1 : 45.2	128	1 : 8	4
1 : 32	64	1 : 5.6	2
1 : 22.6	32	1 : 4	1
1 : 16	16	1 : 2.8	$^1/_2$

The following tables of stops, arranged according to this system, are applicable to our photographic objectives. The values of the diameters of the stops are rounded off in whole millimetres in the case of numbres above 10, and in half millimetres in that of numbers under 10.

Table I.

Tables of Diameters of Stops

in U. S. Nos. of the Photographic Society of Great Britain.

Series and No. of lens	Focus of lens		Diameter of stop*) for											U. S.
			1 : 64	45.2	32	22.6	16	11.3	8	5.6	5	4.5	4	Rel. Aperture
			No. **256**	**128**	**64**	**32**	**16**	8	**4**	**2**	**1.6**	**1.3**	**1**	Rel. Exposure
	mm	in.	Millimetres											
I^a, 1	20	$^{13}/_{16}$	—	—	0.5	—	1.0	1.5	2.0	3.0	3.0	3.5	—	
I^a, 2	35	$1^3/_8$	—	0.5	—	1.0	1.5	2.5	3.5	5.0	5.5	6.0	—	
I^a, 3	50	$1^{15}/_{16}$	0.5	1.0	1.0	1.5	2.5	3.5	5.0	7.0	8.0	9.0	—	
I^a, 4	75	$2^{15}/_{16}$	1.0	1.5	2.0	2.5	3.5	5.5	7.5	11	12	13	—	
I^a, 5	100	$3^{15}/_{16}$	1.0	2.0	2.5	3.5	5.0	7.0	10	14	16	18	—	
I^a, 6	40	$1^9/_{16}$	0.5	0.5	1.0	1.5	2.0	2.5	4.0	5.5	6.0	7.0	8.0	
I^a, 7	60	$2^3/_8$	0.5	1.0	1.5	2.0	3.0	4.0	5.5	8.0	9.0	10	11	
I^a, 8	83	$3^1/_4$	1.0	1.5	2.0	3.0	4.0	5.5	8.0	11	13	14	16	
I^a, 9	110	$4^5/_{16}$	1.5	2.0	2.5	3 5	5.0	7.5	10	15	17	19	21	
I^a, 10	130	$5^1/_8$	1.5	2.0	3.0	4.5	6.0	8.5	12	18	20	22	25	
I^a, 11	160	$6^1/_4$	2.0	2.5	4.0	5.5	7.5	11	15	21	24	27	30	
I^a, 12	205	$8^1/_{16}$	2.5	3.5	5.0	7.0	10	14	20	28	32	35	39	
I^a, 13	250	$9^{13}/_{16}$	3.0	4.0	6.0	8.5	12	17	24	34	38	43	48	
I^a, 14	300	$11^3/_4$	3.5	5.0	7.0	10	14	20	28	40	46	51	—	
I^a, 15	370	$14^1/_2$	4.5	6.5	9.5	13	19	27	38	53	60	67	—	
I^a, 16	423	$16^5/_8$	5.5	7.5	11	15	21	30	43	60	68	76	—	
I^a, 17	470	$18^7/_{16}$	6.0	8.5	12	17	24	34	48	67	76	—	—	
I^a, 18	610	$23^{15}/_{16}$	7.5	11	15	22	31	43	61	87	98	—	—	

Series and No. of lens	Focus of lens		Diameter of stop for											U. S.
			1 : 64	45.2	32	22.6	16	11.3	8	5.6	5.3	5	4.5	Rel. Aperture
			No. **256**	**128**	**64**	**32**	**16**	**9**	**4**	**2**	**1.8**	**1.6**	**1.3**	Rel. Exposure
	mm	in.	Millimetres											
I^b, 3	112	$4^3/_8$	1.5	2.0	3.0	4.5	6.0	8.5	12	17	—	20	22	
I^b, 4	136	$5^{11}/_{32}$	2.0	2.5	3.5	5.5	7.5	11	15	21	—	24	27	
I^b, 5	155	$6^1/_8$	2.0	3.0	4.0	6.0	8.5	12	17	24	—	27	—	
I^b, 6	210	$8^1/_4$	3.0	4.0	6.0	8.0	11	16	23	33	—	37	—	
I^b, 7	255	10	3.5	5.0	7.0	10	14	20	28	40	—	45	—	
I^b, 8	305	12	4.0	6.0	8.5	12	17	24	34	48	—	54	—	
I^b, 9	375	$14^3/_4$	5.0	7.5	10	15	21	29	41	—	62	—	—	
I^b, 10	460	$18^1/_{16}$	6.5	9.0	13	18	25	36	51	72	—	—	—	

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*) In calculating the English equivalents sufficient accuracy for practical purposes will be obtained by taking 3 mm = $^1/_8$ inch for the smaller, and 25 mm = 1 inch for the larger dimensions.

Table II.

Tables of Diameters of Stops
in U. S. Nos. of the Photographic Society of Great Britain.

Series and No. of lens	Focus of lens		Diameter of stop for							U. S.
	mm	in.	1 : 64	45.2	32	22.6	16	11.3	8	Relative Aperture
			No. **256**	**128**	**64**	**32**	**16**	**8**	**4**	Relative Exposure
			Millimetres							
II^{a}, 0	90	$3^{1}/_{2}$	1.0	1.5	2.5	3.5	5.0	7.0	9.5	
II^{a}, 1	110	$4^{5}/_{16}$	1.5	2.0	3.0	4.0	6.0	8.0	12	
II^{a}, 2	136	$5^{5}/_{16}$	2.0	2.5	3.5	5.0	7.0	10	14	
II^{a}, 3	167	$6^{1}/_{2}$	2.0	3.0	4.5	6.5	9.0	13	18	
II^{a}, 4	205	$8^{1}/_{16}$	2.5	4.0	5.5	7.5	11	15	22	
II^{a}, 5	244	$9^{9}/_{16}$	3.0	4.5	6.5	9.0	13	18	26	
II^{a}, 6	295	$11^{9}/_{16}$	4.0	5.5	8.0	11	16	22	31	
II^{a}, 7	350	$13^{3}/_{4}$	4.5	6.5	9.5	13	19	26	37	
II^{a}, 8	433	17	5.5	8.0	12	16	23	33	46	

Series and No. of lens	Focus of lens		Diameter of stop for							U. S.
	mm	in.	1 : 64	45.2	32	22.6	16	11.3	9	Relative Aperture
			No. **256**	**128**	**64**	**32**	**16**	**8**	**5.1**	Relative Exposure
			Millimetres							
III^{a}, 0	75	$2^{15}/_{16}$	1.0	1.5	2.0	3.0	4.0	6 0	7.5	
III^{a}, 00	95	$3^{3}/_{4}$	1.5	2.0	2.5	3.5	5.0	7.5	9.5	
III^{a}, 1	120	$4^{3}/_{4}$	1.5	2.5	3.5	4.5	6.5	9.5	12	
III^{a}, 2	150	$5^{15}/_{16}$	2.0	3.0	4.0	6.0	8.5	12	15	
III^{a}, 3	172	$6^{3}/_{4}$	2.5	3.5	5.0	6.5	9.5	14	17	
III^{a}, 4	196	$7^{11}/_{16}$	2.5	4.0	5.5	7.5	11	15	20	
III^{a}, 5	230	9	3.0	4.5	6.5	9.0	13	18	23	
III^{a}, 6	272	$10^{11}/_{16}$	3.5	5.0	7.5	10	15	21	27	
III^{a}, 7	317	$12^{7}/_{16}$	4.5	6.5	9.0	13	18	25	32	
III^{a}, 8	407	16	5.5	8.0	11	16	22	32	41	
III^{a}, 9	505	$19^{7}/_{8}$	7.0	10	14	20	28	39	50	
III^{a}, 10	600	$23^{5}/_{8}$	8.5	12	17	24	34	48	60	
III^{a}, 11	690	$27^{1}/_{8}$	9.5	14	19	27	39	55	68	
III^{a}, 12	820	$32^{1}/_{4}$	11	16	23	32	46	64	82	

Series and No. of lens	Focus of lens		Diameter of stop for							U. S.
	mm	in.	1 : 64	45.2	32	22.6	18			Relative Aperture
			No. **256**	**128**	**64**	**32**	**20.3**			Relative Exposure
			Millimetres							
V, 0	40	$1^{9}/_{16}$	0.5	0.5	1.0	1.5	2.0			
V, 00	62	$2^{7}/_{16}$	1.0	1.5	2.0	2.5	3.0			
V, 1	86	$3^{3}/_{8}$	1.0	2.0	2.5	3.5	4.5			
V, 2	112	$4^{3}/_{8}$	1.5	2.5	3.0	4.5	6.0			
V, 3	141	$5^{1}/_{2}$	2.0	3.0	4.0	6.0	7.5			
V, 4	182	$7^{1}/_{8}$	2.5	3.5	5.5	7.5	9.5			
V, 5	212	$8^{5}/_{16}$	3.0	4.5	6.0	8.5	11			
V, 6	265	$10^{7}/_{16}$	4.0	5.5	7.5	11	14			
V, 7	315	$12^{3}/_{8}$	4.5	6.5	9.0	13	16			
V, 7^{a}	390	$15^{3}/_{8}$	5.5	8.0	11	16	20			
V, 8	460	$18^{1}/_{16}$	6.5	9.5	13	19	24			
V, 9	632	$24^{13}/_{16}$	9.0	13	18	26	33			
V, 10	947	$37^{3}/_{16}$	14	19	27	39	49			

Table III.

Tables of Diameters of Stops
in U. S. Nos. of the Photographic Society of Great Britain.

Series and No. of lens	Focus of lens		Diameter of stop for							U. S. Relative Aperture Relative Exposure
	mm	in.	1 : 64 No. **256**	45.2 **128**	32 **64**	22.6 **32**	16 **16**	12.5 **9.6**	11 **8**	
			Millimetres							
VII, 0	100	$3^{15}/_{16}$	1.5	2.5	3.0	4.5	6.5	8.0	9.0	
VII, 00	135	$5^{5}/_{16}$	2.0	3.0	4.5	6.0	8.5	11	12	
VII, 000	170	$6^{11}/_{16}$	2.5	4.0	5.5	7.5	11	14	15	
VII, 1	183	$7^{3}/_{16}$	3.0	4.0	5.5	8.0	11	15	—	
VII, 2	224	$8^{13}/_{16}$	3.5	5.0	7.0	10	14	18	—	
VII, 3	285	$11^{3}/_{16}$	4.5	6.5	9.0	13	18	23	—	
VII, 4	350	$13^{3}/_{4}$	5.5	8.0	11	16	22	28	—	
VII, 5	412	$16^{3}/_{16}$	6.5	9.0	13	18	26	33	—	
VII, 6	480	$18^{7}/_{8}$	7.5	11	15	21	30	39	—	
VII, 7	590	$23^{3}/_{16}$	9.0	13	18	26	37	47	—	
VII, 8	690	$27^{1}/_{8}$	11	15	22	31	43	55	—	
VII, 9	782	$30^{3}/_{4}$	12	17	24	35	49	63	—	
VII, 10	862	$33^{13}/_{16}$	13	19	27	38	54	69	—	
VII, 11	1000	$39^{1}/_{4}$	16	22	31	44	63	80	—	

Series and No. of lens	Combination of Foci				Resulting Focus		Diameter of stop for									U. S. Rel. Aperture Rel. Exposure
	mm		in.		mm	in.	1 : 64 No. **256**	45.2 **128**	32 **64**	22.6 **32**	16 **16**	11.3 **8**	8 **4**	7.2 **3.2**	6.3 **2.4**	
							Millimetres									
VII^{a}, 0	100,	100	$3^{15}/_{16}$,	$3^{15}/_{16}$	61	$2^{3}/_{8}$	1.0	1.0	1.5	2.5	3.0	4.5	6.5	7.0	8.0	
VII^{a}, 00	135,	135	$5^{5}/_{16}$,	$5^{5}/_{16}$	82	$3^{1}/_{4}$	1.0	1.5	2.0	3.0	4.5	6.0	8.5	9.5	11	
VII^{a}, 000	170,	170	$6^{11}/_{16}$,	$6^{11}/_{16}$	102	4	1.5	2.0	2.5	4.0	5.5	7.5	11	12	14	
VII^{a}, 1	183,	183	$7^{3}/_{16}$,	$7^{3}/_{16}$	105	$4^{1}/_{8}$	1.5	2.0	3.0	4.0	5.5	8.0	11	13	15	
VII^{a}, 2	224,	183	$9^{1}/_{16}$,	$7^{3}/_{16}$	115	$4^{9}/_{16}$	1.5	2.0	3.0	4.5	6.5	9.0	13	14	—	
VII^{a}, 3	285,	183	$11^{3}/_{16}$,	$7^{3}/_{16}$	127	5	1.5	2.5	3.5	5.0	7.0	10	14	—	—	
VII^{a}, 4	224,	224	$9^{1}/_{16}$,	$9^{1}/_{16}$	128	$5^{1}/_{32}$	1.5	2.5	3.5	5.0	7.0	10	14	16	18	
VII^{a}, 5	285,	224	$11^{3}/_{16}$,	$9^{1}/_{16}$	143	$5^{5}/_{8}$	2.0	3.0	4.0	5.5	8.0	11	16	17	—	
VII^{a}, 6	350,	224	$13^{3}/_{4}$,	$9^{1}/_{16}$	156	$6^{1}/_{8}$	2.0	3.0	4.5	6.0	8.5	12	17	—	—	
VII^{a}, 7	285,	285	$11^{3}/_{16}$,	$11^{3}/_{16}$	163	$6^{3}/_{8}$	2.0	3.0	4.5	6.5	9.0	13	18	20	23	
VII^{a}, 8	350,	285	$13^{3}/_{4}$,	$11^{3}/_{16}$	179	7	2.5	3.5	5.0	7.0	10	14	20	22	—	
VII^{a}, 9	412,	285	$16^{1}/_{8}$,	$11^{3}/_{16}$	192	$7^{1}/_{2}$	2.5	3.5	5.5	7.5	11	15	21	—	—	
VII^{a}, 10	350,	350	$13^{3}/_{4}$,	$13^{3}/_{4}$	200	$7^{7}/_{8}$	2.5	4.0	5.5	8.0	11	16	22	24	28	
VII^{a}, 11	412,	350	$16^{1}/_{8}$,	$13^{3}/_{4}$	216	$8^{7}/_{16}$	3.0	4.0	6.0	8.5	12	17	24	26	—	
VII^{a}, 12	480,	350	$18^{7}/_{8}$,	$13^{3}/_{4}$	232	$9^{1}/_{8}$	3.0	4.5	6.5	9.0	13	18	25	—	—	
VII^{a}, 13	412,	412	$16^{1}/_{8}$,	$16^{1}/_{8}$	235	$9^{1}/_{8}$	3.0	4.5	6.5	9.0	13	18	26	29	33	
VII^{a}, 14	480,	412	$18^{7}/_{8}$,	$16^{1}/_{8}$	254	10	3.5	5.0	7.0	10	14	20	28	31	—	
VII^{a}, 15	590,	412	$23^{1}/_{8}$,	$16^{1}/_{8}$	277	$10^{7}/_{8}$	4.0	5.5	7.5	11	15	22	30	—	—	
VII^{a}, 16	480,	480	$18^{7}/_{8}$,	$18^{7}/_{8}$	275	$10^{13}/_{16}$	4.0	5.5	7.5	11	15	21	30	33	39	
VII^{a}, 17	590,	480	$23^{1}/_{8}$,	$18^{7}/_{8}$	303	$11^{7}/_{8}$	4.0	6.0	8.5	12	17	24	33	37	—	
VII^{a}, 18	690,	480	$27^{1}/_{8}$,	$18^{7}/_{8}$	324	$12^{11}/_{16}$	4.5	6.5	9.0	13	18	25	36	—	—	
VII^{a}, 19	590,	590	$23^{1}/_{8}$,	$23^{1}/_{8}$	337	$13^{1}/_{4}$	4.5	6.5	9.0	13	18	26	37	41	47	
VII^{a}, 20	690,	590	$27^{1}/_{8}$,	$23^{1}/_{8}$	364	$14^{5}/_{16}$	5.0	7.0	10	14	20	28	40	44	—	
VII^{a}, 22	690,	690	$27^{1}/_{8}$,	$27^{1}/_{8}$	395	$15^{1}/_{2}$	5.5	7.5	11	15	22	31	43	48	55	
VII^{a}, 25	782,	782	$30^{11}/_{16}$,	$30^{11}/_{16}$	465	$18^{1}/_{4}$	6.0	8.5	12	17	24	35	49	54	63	
VII^{a}, 28	862,	862	$33^{13}/_{16}$,	$33^{13}/_{16}$	515	$20^{1}/_{4}$	7.0	9.5	13	19	27	38	54	60	69	
VII^{a}, 30	1000,	1000	$39^{1}/_{4}$,	$39^{1}/_{4}$	595	$23^{3}/_{8}$	8.0	11	16	22	31	44	63	70	80	

Dr. P. RUDOLPH's System of Stops. In the system described on the preceding pages the relative aperture $^1/_4$ has been taken as the starting point, though without any substantial reason, and the other relative apertures have been derived from it in accordance with the requirement that the next smaller demands double the exposure of the preceding larger aperture. Others have proposed a system based on $^1/_{100}$ and composed of the series $^1/_{100}$, $^1/_{71 \cdot 5}$, $^1/_{50}$, $^1/_{36}$, $^1/_{25}$, $^1/_{18}$, $^1/_{12 \cdot 5}$, $^1/_{9}$, $^1/_{6 \cdot 3}$, $^1/_{4 \cdot 5}$, $^1/_{3 \cdot 2}$. In this system $^1/_{50}$ is the smallest aperture which is practically available in fine work, and $^1/_{3 \cdot 2}$ may be regarded as the largest practically useful aperture.

Objection may also be raised against the U. S. Nos. of the system of the Royal Photographic Society of Great Britain on the ground of the smaller apertures being expressed by large numbers, whereas it would appear to be much more rational to distinguish small apertures by small numbers. It will be readily appreciated that, with large apertures, exposures cannot be compared with any degree of precision, since the exposures are then but minute fractions of a second. These fractions of a second cannot, in the absence of suitable instruments, be determined with any approach to accuracy, and no reliance can be placed in this respect on the indications of the instantaneous shutters. When, however, the apertures are small, the exposures extend to several seconds, perhaps even to a minute or more, and then it becomes easy to make a satisfactory comparison of the exposure required for different stops. The numbers of the stops corresponding to the small apertures are therefore those which interest us chiefly from a practical point of view, and since it is more convenient to operate with small numbers, it is obviously desirable to reserve these for the discrimination of small apertures. It might be suggested that in this series the numbers of the stops should advance directly as the exposure periods; but as this would necessitate the use of fractions in numbering the large apertures, the suggestion is, practically considered, of doubtful value. The necessity of integral numbers for the sake of convenience will, however, be met if the numbers of the stops are made to advance in the same ratio as the corresponding rapidities, and it only remains to remember that the rapidities due to two stops, i. e., their relative rapidities, are inversely related as the corresponding relative exposures.

As we have already pointed out, it may be assumed that a stop yielding a relative aperture of $^1/_{50}$ is the smallest stop which is available for fine work. We have therefore in this system adopted **a stop corresponding to relative aperture $^1/_{50}$ as equal to the unit of relative rapidity.** Accordingly we obtain the following series of numbered stops:

Relative aperture of the stop $1 : \lambda$	**Relative rapidity** (corresponding No. of stop) $L = \left(\frac{50}{\lambda}\right)^2$	**Relative aperture** of the stop $1 : \lambda$	**Relative rapidity** (corresponding No. of stop) $L = \left(\frac{50}{\lambda}\right)^2$
1 : 50	1	1 : 9	32
1 : 36	2	1 : 6.3	64
1 : 25	4	1 : 4.5	128
1 : 18	8	1 : 3.2	256
1 : 12.5	16		

In this series the exposures corresponding to the stops are inversely related — other things being equal — as the numbers by which they are distinguished. Thus, let stop No. 2 require an exposure of 4 seconds, then, other things being equal, stop No. 8 will necessitate an exposure of 1 second only.

In the succeeding tables, arranged on this system, the values of the diameters of the apertures are rounded off in whole millimetres in the case of numbers above 10, and in one-tenths of a millimetre for numbers under 10.

Table I.

Tables of Diameters of Stops

in accordance with Dr. P. RUDOLPH's system of stops.

Series and No. of lens	Focus of lens mm	Focus of lens in.	Diameter of stop for 1 : 50 No. 1	36 2	25 4	18 8	12.5 16	9 32	6.3 64	5 100	4.5 128	4 156	Rel. Aperture Rel. Rapidity
			Millimetres										
Iª, 1	20	13/16	0.3	0.4	0.6	0.9	1.3	1.8	2.5	3.2	3.5	—	
Iª, 2	35	1 3/8	0.6	0.8	1.1	1.5	2.2	3.1	4.4	5.5	6.1	—	
Iª, 3	50	1 15/16	0.8	1.1	1.6	2.2	3.2	4.4	6.3	7.9	8.8	—	
Iª, 4	75	2 15/16	1.2	1.7	2.4	3.3	4.8	6.6	9.6	12	13	—	
Iª, 5	100	3 15/16	1.6	2.2	3.2	4.4	6.4	8.9	13	16	18	—	
Iª, 6	40	1 9/16	0.6	0.9	1.2	1.7	2.5	3.4	5.0	6.2	6.9	7.8	
Iª, 7	60	2 3/8	0.9	1.2	1.8	2.5	3.6	5.0	7.2	9.0	10	11	
Iª, 8	83	3 1/4	1.3	1.8	2.5	3.5	5.1	7.0	10	13	14	16	
Iª, 9	110	4 5/16	1.7	2.3	3.3	4.6	6.7	9.3	13	17	19	21	
Iª, 10	130	5 1/8	2.0	2.7	4.0	5.5	7.9	11	16	20	22	25	
Iª, 11	160	6 1/4	2.4	3.4	4.9	6.7	9.7	14	19	24	27	30	
Iª, 12	205	8 1/16	3.1	4.4	6.3	8.7	13	18	25	32	35	39	
Iª, 13	250	9 13/16	3.8	5.4	7.6	11	15	22	31	38	43	48	
Iª, 14	300	11 3/4	4.5	6.4	9.1	13	18	26	36	46	51	—	
Iª, 15	370	14 1/2	6.0	8.4	12	17	24	33	48	60	67	—	
Iª, 16	423	16 5/8	6.8	9.5	14	19	27	38	55	68	76	—	
Iª, 17	470	18 7/16	7.6	11	15	21	31	42	61	76	—	—	
Iª, 18	610	23 15/16	9.8	14	20	27	39	55	79	98	—	—	

Series and No. of lens	Focus of lens mm	Focus of lens in.	Diameter of stop for 1 : 50 No. 1	36 2	25 4	18 8	12.5 16	9 32	6.3 64	5.6 80	5.3 89	5 100	4.5 128	Rel. Aperture Rel. Rapidity
			Millimetres											
Iᵇ, 3	112	4 3/8	2.0	2.7	3.9	5.4	7.8	11	16	—	—	20	22	
Iᵇ, 4	136	5 11/32	2.4	3.3	4.8	6.6	9.6	13	19	—	—	24	27	
Iᵇ, 5	155	6 1/8	2.7	3.8	5.4	7.6	11	15	22	—	—	27	—	
Iᵇ, 6	210	8 1/4	3.7	5.1	7.4	10	15	21	29	—	—	37	—	
Iᵇ, 7	255	10	4.5	6.3	9.0	13	18	25	36	—	—	45	—	
Iᵇ, 8	305	12	5.4	7.5	11	15	22	30	43	—	—	54	—	
Iᵇ, 9	375	14 3/4	6.5	9	13	18	26	37	53	—	62	—	—	
Iᵇ, 10	460	18 1/16	8.0	11	16	22	32	45	65	72	—	—	—	

Table II.

Tables of Diameters of Stops

in accordance with Dr. P. RUDOLPH's system of stops.

Series and No. of lens	Focus of lens mm	Focus of lens in.	Diameter of stop for 1 : 50 No. **1**	36 **2**	25 **4**	18 **8**	12.5 **16**	9 **32**	8 **39**	Rel. Aperture Rel. Rapidity
			Millimetres							
II^{a}, 0	90	$3^{1}/_{2}$	1.5	2.2	3.1	4.3	6.2	8.7	9.6	
II^{a}, 1	110	$4^{5}/_{16}$	1.9	2.6	3.7	5.2	7.4	10	12	
II^{a}, 2	136	$5^{5}/_{16}$	2.3	3.2	4.6	6.5	9.2	13	14	
II^{a}, 3	167	$6^{1}/_{2}$	2.8	4.0	5.7	8.0	11	16	18	
II^{a}, 4	205	$8^{1}/_{16}$	3.5	4.9	7.0	9.8	14	20	22	
II^{a}, 5	244	$9^{9}/_{16}$	4.1	5.8	8.3	12	17	23	26	
II^{a}, 6	295	$11^{9}/_{16}$	5.0	7.0	10	14	20	28	31	
II^{a}, 7	350	$13^{3}/_{4}$	6.0	8.4	12	17	24	33	37	
II^{a}, 8	433	17	7.3	10	15	21	29	41	46	

Series and No. of lens	Focus of lens mm	Focus of lens in.	Diameter of stop for 1 : 50 No. **1**	36 **2**	25 **4**	18 **8**	12.5 **16**	9 **32**	Rel. Aperture Rel. Rapidity
			Millimetres						
III^{a}, 0	75	$2^{15}/_{16}$	1.3	1.9	2.6	3.7	5.3	7.5	
III^{a}, 00	95	$3^{3}/_{4}$	1.7	2.4	3.4	4.7	6.7	9.4	
III^{a}, 1	120	$4^{3}/_{4}$	2.1	3.0	4.2	6.0	8.5	12	
III^{a}, 2	150	$5^{15}/_{16}$	2.7	3.8	5.4	7.5	11	15	
III^{a}, 3	172	$6^{3}/_{4}$	3.1	4.3	6.1	8.6	12	17	
III^{a}, 4	196	$7^{11}/_{16}$	3.5	4.9	6.9	9.8	14	20	
III^{a}, 5	230	9	4.1	5.7	8.1	11	16	23	
III^{a}, 6	272	$10^{11}/_{16}$	4.8	6.8	9.6	14	19	27	
III^{a}, 7	317	$12^{7}/_{16}$	5.6	7.9	11	16	22	32	
III^{a}, 8	407	16	7.2	10	15	20	29	41	
III^{a}, 9	505	$19^{7}/_{8}$	8.9	13	18	25	36	50	
III^{a}, 10	600	$23^{5}/_{8}$	11	15	21	30	42	60	
III^{a}, 11	690	$27^{1}/_{8}$	12	17	24	34	49	68	
III^{a}, 12	820	$32^{1}/_{4}$	15	20	29	41	58	82	

Series and No. of lens	Focus of lens mm	Focus of lens in.	Diameter of stop for 1 : 50 No. **1**	36 **2**	25 **4**	18 **8**	Relative Aperture Relative Rapidity
			Millimetres				
V, 0	40	$1^{9}/_{16}$	0.7	1.0	1.5	2.1	
V, 00	62	$2^{7}/_{16}$	1.1	1.6	2.3	3.2	
V, 1	86	$3^{3}/_{8}$	1.6	2.2	3.2	4.6	
V, 2	112	$4^{3}/_{8}$	2.0	3.0	4.2	6.0	
V, 3	141	$5^{1}/_{2}$	2.6	3.6	5.2	7.4	
V, 4	182	$7^{1}/_{8}$	3.4	4.8	6.8	9.6	
V, 5	212	$8^{5}/_{16}$	4.0	5.6	7.8	11	
V, 6	265	$10^{7}/_{16}$	5.0	7.0	9.8	14	
V, 7	315	$12^{3}/_{8}$	5.8	8.2	11	16	
V, 7^{a}	390	$15^{3}/_{8}$	7.2	10	14	20	
V, 8	460	$18^{1}/_{16}$	8.4	12	17	24	
V, 9	632	$24^{13}/_{16}$	12	16	23	33	
V, 10	947	$37^{3}/_{16}$	17	25	35	49	

Table III.

Tables of Diameters of Stops

in accordance with Dr. P. RUDOLPH's system of stops.

Series and No. of lens	Focus of lens mm	Focus of lens in.	Diameter of stop for 1 : 50	36	25	18	12.5	11	Rel. Aperture
			1	2	4	8	**16**	21	Rel. Rapidity
			Millimetres						
VII, 0	100	$3^{15}/_{16}$	2.0	2.8	4.1	5.7	8.2	9.0	
VII, 00	135	$5^{5}/_{16}$	2.8	3.8	5.5	7.6	11	12	
VII, 000	170	$6^{11}/_{16}$	3.4	4.7	6.8	9.4	14	15	
VII, 1	183	$7^{3}/_{16}$	3.7	5.2	7.3	10	15	—	
VII, 2	224	$8^{13}/_{16}$	4.5	6.3	8.9	13	18	—	
VII, 3	285	$11^{3}/_{16}$	5.7	8.0	11	16	23	—	
VII, 4	350	$13^{3}/_{4}$	7.0	9.9	14	20	28	—	
VII, 5	412	$16^{3}/_{16}$	8.2	12	17	23	33	—	
VII, 6	480	$18^{7}/_{8}$	9.6	14	19	27	39	—	
VII, 7	590	$23^{3}/_{16}$	12	17	24	33	47	—	
VII, 8	690	$27^{1}/_{8}$	14	20	28	39	55	—	
VII, 9	782	$30^{3}/_{4}$	16	22	31	43	63	—	
VII, 10	862	$33^{13}/_{16}$	17	24	34	48	69	—	
VII, 11	1000	$39^{1}/_{4}$	20	28	40	56	80	—	

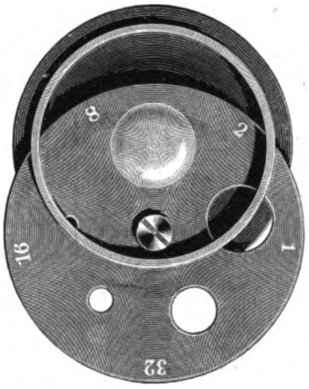
Series and No. of lens	Combination of Foci mm	Combination of Foci in.	Resulting focus mm	Resulting focus in.	Diameter of stop for 1 : 50	36	25	18	12.5	9	8	7.2	6.5	Rel.Aperture
					No. 1	2	4	8	**16**	**32**	**39**	**48**	**64**	Rel.Rapidity
					Millimetres									
VII^{a}, 0	100, 100	$3^{15}/_{16}$, $3^{15}/_{16}$	61	$2^{3}/_{8}$	1.0	1.4	2.0	2.8	4.1	5.7	6.4	7.1	8.2	
VII^{a}, 00	135, 135	$5^{5}/_{16}$, $5^{5}/_{16}$	82	$3^{1}/_{4}$	1.4	1.9	2.8	3.8	5.5	7.6	8.6	9.5	11	
VII^{a}, 000	170, 170	$6^{11}/_{16}$, $6^{11}/_{16}$	102	4	1.7	2.4	3.4	4.7	6.8	9.4	11	12	14	
VII^{a}, 1	183, 183	$7^{3}/_{16}$, $7^{3}/_{16}$	105	$4^{1}/_{8}$	1.8	2.6	3.7	5.2	7.3	10	11	13	15	
VII^{a}, 2	224, 183	$9^{1}/_{16}$, $7^{3}/_{16}$	115	$4^{9}/_{16}$	2.0	2.8	4.0	5.7	8.0	11	12	14	—	
VII^{a}, 3	285, 183	$11^{3}/_{16}$, $7^{3}/_{16}$	127	5	2.2	3.1	4.5	6.3	8.9	13	14	—	—	
VII^{a}, 4	224, 224	$9^{1}/_{16}$, $9^{1}/_{16}$	128	$5^{1}/_{32}$	2.2	3.2	4.5	6.3	9.0	13	14	16	18	
VII^{a}, 5	285, 224	$11^{3}/_{16}$, $9^{1}/_{16}$	143	$5^{5}/_{8}$	2.5	3.5	5.0	7.0	10	14	16	17	—	
VII^{a}, 6	350, 224	$13^{3}/_{4}$, $9^{1}/_{16}$	156	$6^{1}/_{8}$	2.7	3.8	5.5	7.7	11	15	17	—	—	
VII^{a}, 7	285, 285	$11^{3}/_{16}$, $11^{3}/_{16}$	163	$6^{3}/_{8}$	2.9	4.0	5.7	8.0	11	16	18	20	23	
VII^{a}, 8	350, 285	$13^{3}/_{4}$, $11^{3}/_{16}$	179	7	3.1	4.4	6.3	8.8	13	18	20	22	—	
VII^{a}, 9	412, 285	$16^{1}/_{8}$, $11^{3}/_{16}$	192	$7^{1}/_{2}$	3.4	4.7	6.7	9.5	14	19	21	—	—	
VII^{a}, 10	350, 350	$13^{3}/_{4}$, $13^{3}/_{4}$	200	$7^{7}/_{8}$	3.5	4.9	7.0	9.9	14	20	22	24	28	
VII^{a}, 11	412, 350	$16^{1}/_{8}$, $13^{3}/_{4}$	216	$8^{7}/_{16}$	3.8	5.3	7.6	11	15	21	24	26	—	
VII^{a}, 12	480, 350	$18^{7}/_{8}$, $13^{3}/_{4}$	232	$9^{1}/_{8}$	4.1	5.7	8.1	11	16	23	25	—	—	
VII^{a}, 13	412, 412	$16^{1}/_{8}$, $16^{1}/_{8}$	235	$9^{1}/_{8}$	4.1	5.8	8.2	12	17	23	26	29	33	
VII^{a}, 14	480, 412	$18^{7}/_{8}$, $16^{1}/_{8}$	254	10	4.4	6.2	8.9	13	18	25	28	31	—	
VII^{a}, 15	590, 412	$23^{1}/_{8}$, $16^{1}/_{8}$	277	$10^{7}/_{8}$	4.8	6.8	9.7	14	19	27	30	—	—	
VII^{a}, 16	480, 480	$18^{7}/_{8}$, $18^{7}/_{8}$	275	$10^{13}/_{16}$	4.8	6.8	9.6	14	19	27	30	33	39	
VII^{a}, 17	590, 480	$23^{1}/_{8}$, $18^{7}/_{8}$	303	$11^{7}/_{8}$	5.3	7.5	11	15	21	30	33	37	—	
VII^{a}, 18	690, 480	$27^{1}/_{8}$, $18^{7}/_{8}$	324	$12^{11}/_{16}$	5.7	8.0	11	16	23	32	36	—	—	
VII^{a}, 19	590, 590	$23^{1}/_{8}$, $23^{1}/_{8}$	337	$13^{1}/_{4}$	5.9	8.3	12	17	24	33	37	41	47	
VII^{a}, 20	690, 590	$27^{1}/_{8}$, $23^{1}/_{8}$	364	$14^{5}/_{16}$	6.4	9.0	13	18	26	36	40	44	—	
VII^{a}, 22	690, 690	$27^{1}/_{8}$, $27^{1}/_{8}$	395	$15^{1}/_{2}$	6.9	9.7	14	19	28	39	43	48	55	
VII^{a}, 25	782, 782	$30^{11}/_{16}$, $30^{11}/_{16}$	465	$18^{1}/_{4}$	7.8	11	16	22	31	43	49	54	63	
VII^{a}, 28	862, 862	$33^{13}/_{16}$, $33^{13}/_{16}$	515	$20^{1}/_{4}$	8.6	12	17	24	34	48	54	60	69	
VII^{a}, 30	1000, 1000	$39^{1}/_{4}$, $39^{1}/_{4}$	595	$23^{3}/_{8}$	10	14	20	28	40	56	63	70	80	

Graduation of the apertures of the Rotating Diaphragms in terms of the relative rapidity.

The wheel-diaphragm is adapted for a small number of apertures only. It is, for this reason, less generally applicable than the iris-diaphragm, which can be adjusted to any intermediate position between its smallest and largest aperture. Practically considered, it is therefore advisable to provide the wheel-diaphragm only with those apertures which are of particular importance for a given objective. Accordingly we graduate the wheel-diaphragm, as a rule, in terms of the relative rapidity, thus:

Relative apertures: 1:50, 1:36, 1:25, 1:18, 1:12.5, 1:9,
Relative rapidity: No. 1, 2, 4, 8, 16, 32.

Our wheel-diaphragms have numbers representing the relative rapidities engraved upon them, the number in the middle of the part of the wheel which projects clear of the mount being the one which stands for the working stop. The arrangement is represented in the subjoined illustration, which shows our Protar 1:9, series III^a, $f = 120$ millimetres ($4^3/_4$ in.) working with stop No. 32, i. e., at 1:9.



Objective Mount with Rotating-Diaphragm
for Protar 1:9, $f = 120$ mm ($4^3/_4$ in.).
(Actual size).
The wheel is set for Stop No. 32,
Relative aperture 1 : 9.

Besides those specified in the catalogue, we are prepared to supply, as far as possible, other small mounts fitted with wheel diaphragms at short notice.

Wheel-diaphragms are preferable to iris-diaphragms if two lenses are required to form a stereoscopic pair, since the former are better adapted than the iris-diaphragms for obtaining exactly similar apertures in both objectives (see VALENTIN LINHOF's Stereoscopic Shutter).

The Characteristic Features of the various types of our objectives.

In regard to the system of construction our photographic objectives divide themselves into three distinct groups, each of them possessing definite characteristic properties corresponding to specific requirements. The first group, which embraces **the "Planar", Series I^a,** supplies objectives peculiarly adapted for certain special classes of work, requiring either a large relative aperture (portraits and very rapid instantaneous exposures), or demanding the special precision and sharpness indispensable in line reproductions, enlargements and very minute reductions. Hence, in constructing the objectives of this group, our aim has been to combine with a large relative aperture the production of such sharply defined pictures as cannot be obtained with any other existing form of objectives using the same aperture.

The second group is represented by the objectives of **Series I^b, the "Unar".** This type commends itself at once by its exceptional rapidity (relative aperture 1/4.5, resp. 1/5 or 1/5.6) and this, coupled with handiness in respect of both size and weight, renders it specially adapted for the manifold purposes of a **hand camera,** such as portrait and group photography, snap shots of street scenes, and landscapes, as also for interior and architectural work where angles of more than about 70° are not required. An eminent expert has found the "Unar" also highly satisfactory for astronomical purposes. From the point of view of its purely optical qualities, in regard to definition and angle of view, it forms a connecting link between the "Planar" and the third group, the "Protar".

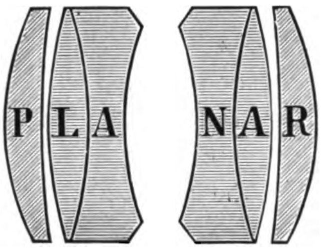
The **"Protar"** group of objectives is remarkable for its universality of application, but some of the various series are better adapted to particular purposes than others, consequently, in making a selection, these special qualities should be kept in view, and the choice should be made from the unsymmetrical doublets of the Series II^a, III^a and V, the Protar-lenses of Series VII, or the Double-Protar, Series VII^a (formed by a combination of two of the latter), all of which are more fully described in the following pages.

The unsymmetrical Protar doublets comprised in Series II^a, III^a and V belong to the class of wide-angle instantaneous objectives, i. e., they possess an anastigmatically flat field of remarkably large angular extent in comparison to their relative aperture. This combination of features renders one and the same lens suitable for instantaneous photography as well as for wide-angle views. Hence the universality of application peculiar to these objectives lies mainly in the fact of it being practicable to use the same lens, **employing**

different sizes of plates, with the best results for a variety of purposes (portraits, instantaneous work, groups, architecture and interiors).

The Double-Protar is, as already stated, composed of two lenses of Series VII which, when used singly, may be recommended for all kinds of work in which, from regard to perspective, the focus must necessarily be long in comparison to the size of the plate used. According to the choice of the combination — whether one of two lenses of similar or of dissimilar focus — a range of two or three foci is obtained, the Double-Protar possessing the shortest focus and greatest rapidity, whilst the single lenses will have the greater focal length, but with correspondingly reduced rapidity. The pith of the matter is that the one pair of Protars gives the choice of different foci, thereby facilitating the taking of a large variety of views (portraits, landscapes, instantaneous and architectural views) **upon the same size of plate.** Having a large relative aperture (great relative rapidity) and an anastigmatically flat field of proportionately wide angular extent, the Double-Protars may also be said to combine in a certain, though less pronounced, degree the universality of the unsymmetrical doublets.

Our „Anleitung und Tabellen zur Auswahl unserer photographischen Objective", which we supply gratis and post free, contains full particulars and may be found a useful guide in the selection of suitable objectives.



1897

The Planar[1].

The Planar is a new type of lens constructed in 1896 after a formula calculated by Dr. P. Rudolph of our scientific staff. It is patented in several countries (German Patent dated 14. Nov. 1896, Patent No. 92313). It was put on the market in August 1897, a descriptive supplement to the June 1897 edition of our Catalogue of Photographic Objectives being published at the same time.

The introduction of the Planar marks an important advance in the improvement of photographic objectives in so far as it furnished the first proof of the feasibility of producing, by comparatively simple means, an anastigmatically flat field simultaneously with the correction of spherical aberrations sufficiently perfect even for slight microscopic enlargements. The means employed are simple, because of the wider range of choice in various classes of glass than was available in the construction of earlier types of anastigmatic doublets, owing to the difficulty of compensating the opposite refractive indices of the crown and flint glasses then used.

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[1] Bibliography:

Carl Zeiss, Jena: German Patent Specification No. 92313, 14. Nov. 1896, and Eder's Jahrbuch für Photographie, 1898, p. 79.

Dr. P. Rudolph, Jena: Brit. Patent Specification No. 27635 of 1896, published in the British Journal of Photography, 1897, p. 424.

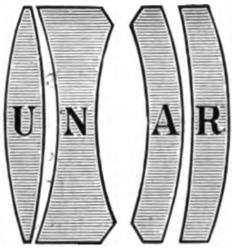
Carl Zeiss, Optical Works, Jena: "The Planar"; published in Aug. 1897 as a supplement to the Catalogue of Photographic Objectives and Photo-optical Appliances of June 1897.

Dr. M. von Rohr, Jena: „Ueber das Planar, ein neues Objectiv aus der optischen Werkstaette von Carl Zeiss in Jena." A paper read at Brunswick on the occasion of the annual meeting for 1897 of the Society for Natural Research; published in Eder's Jahrbuch für Photographie, 1898, annual volume XII, p. 70—78.

Detailed particulars of the new type of lens are given in the German Patent Specification No. 92313, issued on July 5, 1897, of which we will here only reproduce the paragraphs dealing with the distinctive characteristic features of the objective, viz:

1. A system of lenses with anastigmatic flatness of field, consisting of two lenses (a collective and a dispersive one) separated by a medium of low refraction. One, or both, of these lenses are formed of two components cemented together and made of glass of dissimilar dispersion but approximately similar refraction.
2. A double objective employing components of the system of construction described in paragraph 1.

The Unar[1].



1900

The invention of the Unar dates back to 1899, in which year we applied for patents in Germany and several other countries. In this objective Dr. RUDOLPH has produced a type which enables us to attain, by simple means, great rapidity combined with an anastigmatic flatness over a large field. The sale of the new objective commenced in April 1900.

Certain means of correction were applied to the Unar which bear resemblance in some respect to those employed in both the Planar and the Protar. In its spherical and anastigmatic correction, effected exclusively by the separation of the lenses, the Unar resembles the Planar, but while the Planar shows no appreciable dissimilarity in the components separated by the diaphragm, and is practically of symmetrical construction, the Unar, in its simplest form of a double objective, resembles the Protar in that its components

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[1] Bibliography:

CARL ZEISS, JENA: "The Unar"; published in April 1900 as a supplement to the 1897 edition of the Catalogue of Photographic Objectives.

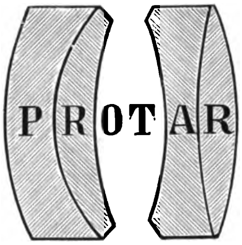
Dr. P. RUDOLPH, JENA: „Das Unar". Photogr. Mittheilungen, Berlin, first number for the month of November 1900.

Carl Zeiss, Optische Werkstaette, Jena.

possess certain opposite qualities, and its construction, in relation to the diaphragm, is on the whole unsymmetrical. In the simple Unar double objective it is necessary to have on one side of the diaphragm an airlens (adjoining the surfaces of two consecutive lenses) with positive, on the other side of the diaphragm a similar lens with negative effect.

The patent specification to be issued at an early date will give fuller details of the system of construction.

At present we make only one series of objectives of the Unar type which have a relative aperture of 1/4.5 to 1/5.6 and a field of view extending to above 65°. They can be specially recommended for hand cameras intended for universal purposes — for portraits, groups, landscapes, and architectural as also for astronomical work.



1890

The Protar[1],

Unsymmetrical Doublets.

The objectives of this category are of the type discovered by Dr. P. Rudolph in 1889. Their formula has been patented by us in several countries (German Patent No. 56 109). A number of series of objectives of this type, adapted for a variety of purposes, have been made after Dr. Rudolph's computations. These series are the following: Series I, having a relative aperture of 1/4.5, Series II, r. a. 1/6.3, Series II^{a}, r. a. 1/8, Series III, r. a. 1/7.2, Series III^{a}, r. a. 1/9, Series IV, r. a. 1/12.5, and Series V, r. a. 1/18. Series I, II, III and IV having been replaced by other and better lenses, we have discontinued their regular manufacture.

This doublet construction possesses the characteristic peculiarity that though both components, consisting of lenses cemented together, are achromatized singly, the positive element (the collective lens) has a lower refractive index in one, and a higher refractive index in the other component than the adjacent negative element (the dispersive lens).

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[1] Bibliography:

Carl Zeiss, Optical Works, Jena: German Patent Specification No. 56109, 3. April 1890, issued 20. May 1891.

Dr. P. Rudolph: Brit. Patent Specification, 24. May 1890, No. 6028, published 11. July 1890 in the British Journal of Photography 1890, p. 443.

Carl Zeiss, Optical Works, Jena: Price List of 1890, Catalogue of May 1891 and Supplement of 1893.

Dr. P. Rudolph: „Ueber den Astigmatismus photographischer Linsen". Eder's Jahrbuch für Photographie, 1891, pp. 225 et seq., and 1893, pp. 221 et seq.

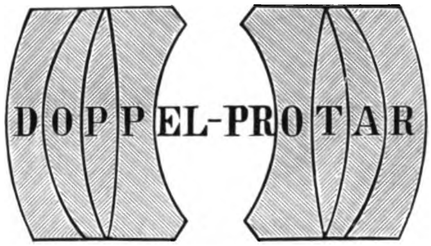
Dr. P. Rudolph: „Die Zeiss-Anastigmate". Photographisches Wochenblatt, Berlin, 1892, Nos. 18 to 21.

The principle of an optical system built up of achromatic sections composed of elements possessing opposite optical properties has been rendered practicable by the judicions application of the barium-silicate glasses of relatively high refractive power made since 1886 in the Glass Works of Messrs. SCHOTT & GENOSSEN of JENA. This combination of elements of such opposite properties is of great advantage in the production of double objectives as it facilitates the perfect correction of the astigmatic aberrations of the oblique pencils without detriment to the flatness of the field.

In computing the lenses of **the various series** we have generally endeavoured to render them as universal as possible, apart from their specific applicability, and, accordingly, we have sought to combine a wide angle and good definition with great rapidity. The various series differ therefore only by their relations of rapidity and angle, the less rapid naturally embracing the widest angle.

The uniformity of the illumination from the centre to the edge of the field is mainly due to the all but complete correction of the astigmatic and spherical aberrations of oblique pencils, to the short form of the Protar, and to the fact that the component lenses are considerably larger in diameter than is really necessary to obtain the largest relative aperture for which the objective is corrected.

Protar-Lenses and Double-Protars1).



1895

The Protar-Lenses embody a modification of the formula of the Protar just described, the same principle of correction being applied to the single objective with the diaphragm in front. They were computed by Dr. P. RUDOLPH in 1894 and first offered for sale in the spring of 1895 under the designation of "Anastigmatlinsen". The Protar-lens of Series VII serves the same purposes, but in a more perfect manner, as the Anastigmatic Combination Lenses2) made by us in 1891 according to Dr. P. RUDOLPH's computations and first offered to the public in 1893 under the headings of Series VI and VI^a. We discontinued therefore the manufacture of these latter series some time ago.

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1) Bibliography:

Dr. P. RUDOLPH: Brit. Patent Specification, 17. Nov. 1894, No. 19509, published in the British Journal of Photography. 1894, 28. XII, p. 829.

CARL ZEISS, Optical Works, JENA: Supplement to the Catalogue „Anastigmatlinse 1 : 12.5“ and „Satz-Anastigmate“, February 1895.

id.: „Ein neues photographisches Objectiv“. Photographische Mittheilungen, Berlin. Vol. 31, 1894—95, p. 355.

2) Dr. P. RUDOLPH: Brit. Patent Specification of 22. April, 1893, No. 4672, published 26. May 1893 in the British Journal of Photography, p. 331.

id.: „Die Zeiss-Anastigmate und deren Verwendbarkeit“, a paper read before the „Verein zur Pflege der Photographie“ in Frankfurt a. M., 6. Sept. 1893, Photographische Correspondenz, Vienna 1893, pp. 512 et seq.

CARL ZEISS, Optical Works, JENA, 1893: Supplement to the Catalogue of Photographic Objectives.

The Protar-lens, Series VII, is a rapid anastigmatic single lens, consisting of four elementary lenses cemented together. The increase in the number of components as compared with our Anastigmatic Combination Lens, Series VI, with relative aperture 1 : 14.5, and which consisted of only three elementary lenses, has enabled us to apply the principle of anastigmatic correction, as first realized in our unsymmetrical Anastigmatic Doublets (the Protars), to the correction of single lenses in a distinctly more perfect manner than the previous limitation to only three elements admitted of.

The application of the formula of our unsymmetrical Anastigmatic Doublets (Protars) to the new quadruple single lens has been achieved by the combination, in contact, of two pairs of lenses, whose positive and negative elements are related to each other with respect to their refractive properties in the same manner as the component lenses of the doublet in question.

The new **Protar-lenses,** whilst in themselves of a very high degree of perfection, admit of being combined in pairs of similar or dissimilar foci so as to form symmetrical doublets (the **Double-Protar**, Series VII^{a}), and such combination constitutes a very perfect anastigmatic Rapid Universal Objective. — Series VII of the Protar-lenses offers at the same time a convenient means of selecting an assortment of convertible objectives (**Protar-sets**) admitting of a very extensive range of application.

Remarks

respecting the particulars contained in the list of prices.

The objectives comprised in the various series are specified in the list of prices by their distinctive numbers.

The sizes of plates shown in the tables represent the covering power obtained with the stop indicated at the head of the columns and it is assumed, unless otherwise stated, that the objects are at a great distance. When the objective is used as an instantaneous or landscape lens with the stop indicated in the table, the picture obtained is sufficiently sharp right to the edge, but when this degree of sharpness is not required, plates can be used considerably larger than indicated in the columns of the tables for the various sizes of stops. If particular value attaches to uniform intensity of light from centre to edge, it is advisable to use smaller stops than shown in the tables, so as to lessen the gradual diminution of the light from the centre to the edge caused, according to well-known mathematical laws, by the effects of stopping at the lens edges.

In estimating the covering power, the amount of depth of definition has been left out of consideration, the depth depending, apart from any possibly existing curvature of the image, exclusively upon the amount of stopping, as well as on the focal length and the distance of the principal object. **Depth cannot, in fact, form any special feature in the correction of the lens.**

The particulars placed under the heading "Diameter of image with small stops" apply to lenses focused upon distant objects. These diameters represent the guaranteed minimum values obtainable with the lenses in question. With small stops an image having this diameter is obtained which is sufficiently sharp for most purposes.

Series I^a^.

THE PLANAR.

German Patent No. 92 313.

Reg^d.^ No. 23 231. 1897.

The Planar of Series I^a consists of four separated lenses. Nos. 1 to 5, which embrace the highest capacity for reductions and enlargements, are constructed strictly symmetrically. The objectives of this series are specially rapid and excel in yielding sharply defined pictures, in being anastigmatically well corrected, and in having a field of relatively large angular extent. The rapidity varies from 1/3.6 to 1/5, the angle of view from 62 to 72°.

As a special objective the Planar is better adapted to certain classes of work than any other type of lens. The smaller sizes are specially applicable to **the preparation of animated pictures,** to **enlargements** and **minute reductions,** as also to **projections;** the larger sizes to all kinds of **reproductions** (Autotype, Photo-gravure etc.). The Planar can also be strongly recommended for **portraits** and for **groups** containing one or two rows. For wide-angle interior views and landscapes, however, the Protars of Series II^a to VII^a incl. and the Unars are preferable to the Planar.

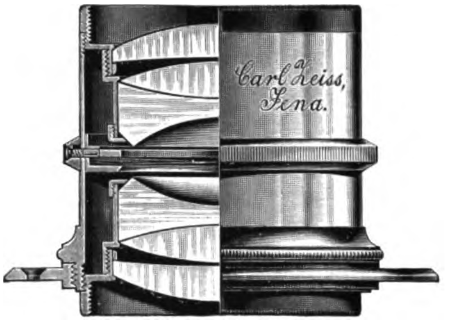
In the selection of an objective it should therefore be borne in mind that for certain special purposes indicated above the Planar is the best objective, but that the choice should fall upon the Protar, Series II^a to VII^a, or upon the Unar, whenever an objective is required for a wide range of application.

The following table shows the eighteen different numbers of Series I^a in which the Planar is regularly made. The table also indicates various dimensions, the size of plates to be used, and the prices. A few remarks on the special application of the different numbers are given on the pages succeeding the table.

When working with the Planar, it should be remembered that, owing to the great rapidity of the lens, one is apt to over-expose. This naturally causes fogging, and hence it is often advisable to make use of a restrainer during the process of development.

THE PLANAR

in Standard Mount with Iris-Diaphragm.



Series and No.	The Planar in Standard Mount: Code-word	The Planar in Standard Mount: Price	Diameter of Lenses	Diameter of Lenses	Equivalent Focus	Equivalent Focus	Extension	Extension	Largest relative aperture	Angle of View	Size of Plate covered at full aperture	Size of Plate covered at full aperture	Size of Plate covered with intermediate stops	Size of Plate covered with intermediate stops	Diameter of image with small stops	Diameter of image with small stops	Standard Mount
		$	mm	in.	mm	in.	mm	in.	1:	Degrees	cm	in.	cm	in.	cm	in.	Nos.
Iª, 1	**Placage**	**35.—**	5	3/16	20	3/4	16	5/8	4.5	65	1.3×1.3	1/2 × 1/2	1.8×1.8	11/16 × 11/16	2.5	1	0
Iª, 2	**Placard**	**35.—**	8	5/16	35	1 3/8	30	1 3/16	4.5	65	2.2×2.2	1/8 × 1/8	3×3	1 3/16 × 1 3/16	4.4	1 3/4	0
Iª, 3	**Placenta**	**35.—**	12	1/2	50	2	42	1 5/8	4.5	65	3×3	1 3/16 × 1 3/16	4.5×4.5	1 3/4 × 1 3/4	6.3	2 1/2	I
Iª, 4	**Placet**	**42.—**	18	11/16	75	3	65	2 1/2	4.5	65	4×4	1 5/8 × 1 5/8	6×6	2 3/8 × 2 3/8	9.5	3 3/4	II
Iª, 5	**Placitum**	**42.—**	25	1	100	4	87	3 3/8	4.5	65	6×6	2 3/8 × 2 3/8	8.5×8.5	3 3/8 × 3 3/8	12.7	5	III
Iª, 6	**Placodus**	**35.—**	12	1/2	40	1 9/16	34	1 3/8	3.6	70	2.6×2.6	1 × 1	4×4	1 5/8 × 1 5/8	5.6	2 3/16	0
Iª, 7	**Plafond**	**35.—**	17	11/16	60	2 3/8	51	2	3.6	70	3.5×3.5	1 3/8 × 1 3/8	6×6	2 3/8 × 2 3/8	8.4	3 1/4	II
Iª, 8	**Plagiat**	**42.—**	23	15/16	83	3 1/4	73	2 7/8	3.6	70	5×5	2 × 2	7×8	2 3/4 × 3 1/8	11.6	4 9/16	III
Iª, 9	**Plagium**	**52.50**	31	1 1/4	110	4 1/4	93	3 5/8	3.6	70	6×9	2 3/8 × 3 1/2	9×10	3 1/2 × 4	15.4	6 1/16	IV₁
Iª, 10	**Plakoid**	**63.—**	36	1 1/2	130	5 1/8	112	4 3/8	3.8	70	8×9	3 1/8 × 3 1/2	10×13	4 × 5 1/8	18.2	7 1/8	V
Iª, 11	**Planeta**	**77.—**	42	1 5/8	160	6 1/4	134	5 1/4	3.8	70	9×12	3 1/2 × 4 3/4	12×17	4 3/4 × 6 3/4	22	8 5/8	VIII
Iª, 12	**Planum**	**108.—**	51	2	205	8	181	7 1/8	4.0	65	12×16	4 3/4 × 6 1/2	13×21	5 1/8 × 8 1/4	26	10 1/4	IXª
Iª, 13	**Plasma**	**150.—**	61	2 3/8	250	9	220	8 5/8	4.0	65	13×18	5 1/8 × 7	18×24	7 × 9 1/2	32	12 1/2	XII
Iª, 14	**Plastik**	**192.—**	71	2 3/4	300	9 13/16	265	10 1/2	4.2	62	16×21	6 1/2 × 8 1/4	21×26	8 1/4 × 10 1/4	36	14 1/8	XIII
Iª, 15	**Plastron**	**240.50**	82	3 1/4	370	14 1/2	327	12 5/8	4.5	72	18×24	7 × 9 1/2	30×40	11 3/4 × 15 3/4	54	21 1/4	XIV
Iª, 16	**Plata**	**300.—**	94	3 3/4	423	16 5/8	374	14 3/4	4.5	72	21×26	8 1/4 × 10 1/4	35×45	13 3/4 × 17 3/4	62	24 3/8	XV
Iª, 17	**Platanus**	**348.50**	94	3 3/4	470	18 1/2	417	16 3/8	5.0	68	24×30	9 1/2 × 11 3/4	40×50	15 3/4 × 19 1/2	63	24 3/4	XV
Iª, 18	**Platinid**	**697.—**	120	4 3/4	610	24	544	21 3/8	5.0	68	30×40	11 3/4 × 15 3/4	50×60	19 1/2 × 23 1/2	82	32 1/4	XVII

When ordering by wire it is sufficient to quote the ***Code-word.***

*By „**Extension**“ is understood the distance of the sharp picture from the face of the camera front when focused for very distant objects.*

The halves of the Planar (front and back lens resp.) do not give sufficiently sharp views of landscape, excepting with very small stops.

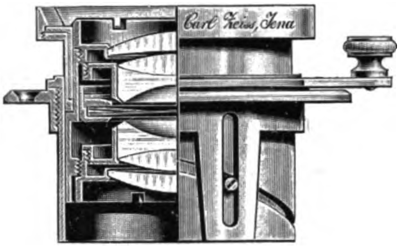
We construct objectives differing in focus and dimension from those specified above, especially lenses required for **Reproductions,** and shall be glad to forward estimates on application. For **Three Colour Printing** we would strongly recommend our Planars **with reduced secondary spectrum.**

In view of the French Patent Laws the objectives of Series Iª must not be introduced into France by way of trade.

THE PLANAR

in Special Mount A

with Iris-Diaphragm and Focusing Attachment.



Objectives in Special Mount *A* are adapted for **Hand Cameras** with fixed extension in which the instantaneous shutter works either directly in front of the sensitive plate or directly behind the objective.

Series and No.	**The Planar** in Special Mount A		Diameter of Lenses		Equivalent Focus		Extension		Size of Plate covered				Special Mount
									from		to		
	Code-word	Price $	mm	in.	mm	in.	mm	in.	cm	in.	cm	in.	No.
I^a, 4	**Placetial**	45.50	18	$\frac{11}{16}$	75	3	77	3	4×4	$1\frac{5}{8} \times 1\frac{5}{8}$	6×6	$2\frac{3}{8} \times 2\frac{3}{8}$	*A* II
I^a, 5	**Placital**	45.50	25	1	100	4	104	$4\frac{1}{8}$	6×6	$2\frac{3}{8} \times 2\frac{3}{8}$	6×9	$2\frac{3}{8} \times 3\frac{1}{2}$	*A* III
I^a, 8	**Plagiatal**	45.50	23	$\frac{15}{16}$	83	$3\frac{1}{4}$	90	$3\frac{1}{2}$	4×6	$1\frac{5}{8} \times 2\frac{3}{8}$	5×8	$2 \times 3\frac{1}{8}$	*A* III
I^a, 9	**Plagiumal**	57.50	31	$1\frac{1}{4}$	110	$4\frac{1}{4}$	123	$4\frac{13}{16}$	6×9	$2\frac{3}{8} \times 3\frac{1}{2}$	8×10	$3\frac{1}{8} \times 4$	*A* IV_1
I^a, 10	**Plakoidal**	68.—	36	$1\frac{1}{2}$	130	$5\frac{1}{8}$	144	$5\frac{5}{8}$	8×10	$3\frac{1}{8} \times 4$	9×12	$3\frac{1}{2} \times 4\frac{3}{4}$	*A* V

*By ,,**Extension**'' is understood the distance of the sharp picture from the face of the camera front when focused for very distant objects.*

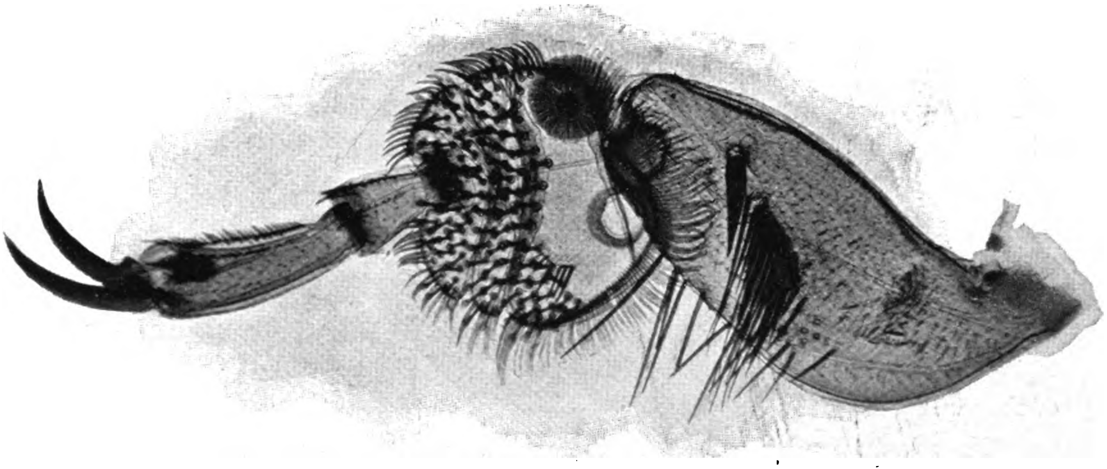
Objectives in Special Mounts A cannot be used in conjunction with Hand Cameras where the shutter works between the lenses of the objective.

Special Applications of the Planar.

Instantaneous Photography. Nos. 4 to 18 of Series I^a are adapted for photographing objects in motion, and the selection in the narrower sense may be governed by reference to the column "Size of Plate covered at full aperture" in the preceding table. For exposures of this kind, which naturally demand as little time as possible, a focal plane shutter, placed immediately in front of the plates, is to be preferred to any other kind of shutter when the plates are of small dimension (up to 18 × 24 cm = 7 × 9$^1/_2$ in.). The photograph should be taken with the largest stop which the required degree of sharpness admits.

For instantaneous street scenes and *genre* pictures the sizes of plates indicated in the column "Size of Plates covered with intermediate stops" are generally applicable. The lens requires in these cases a stop of $^1/_6$ to $^1/_9$, according to its focal length and the required depth of focus.

Portraits and Groups. Nos. 12 to 18 are adapted for this class of work, No. 12 being suitable for portrait Carte de Visite, No. 18 for heads in about $^1/_2$ size, No. 12 for groups measuring 13 × 18 cm (4$^3/_4$ × 7 in.), No. 18 for groups measuring 50 × 60 cm (19$^3/_4$ × 23$^5/_8$ in.). Portraits should be taken with stops of $^1/_{4\cdot5}$ to $^1/_6$, groups with stops of $^1/_6$ to $^1/_{12\cdot5}$, according to the number of rows or the requisite depth of focus. Since even with short exposures the details contained in the shadows are rendered visible, it is advisable to make the exposure as short as possible.



Magnified about 20 times.

Kinematograph Pictures. Animated pictures are conveniently made with Nos. 1 to 4 and Nos. 6 and 7. The special selection depends upon the size of the film to be covered, which can be ascertained from the first column of the table on page 35.

Enlargements and Projections. The smaller sizes of the Planar are adapted in an exceptional degree for photographic enlargements and optical projections. All numbers of Series I^a are equally suitable for moderate enlargements (to about 6 ×), but for greater enlargements (up to 100 ×) Nos. 1 to 5 are preferable. The latter therefore take first place for photo-micrographic work and micro-projections. When working with these Nos. 1 to 5, care should be taken that the side of the mount with "Planar 1:4.5 $F =$ .... mm" engraved on it is turned towards the object to be enlarged. With Nos. 6 to 18 it is immaterial how the objective is screwed on.

Planars Nos. 1 and 2 are fitted with the Royal Microscopical Society's screw.

Reductions. In addition to enlargements, the smaller sizes of the Planar — especially Nos. 1 to 5 — are also well adapted for the most minute reductions requiring great sharpness such, for instance, as are used in communications by carrier pigeons. With Nos. 1 to 5 the mount is to be screwed in so that the end bearing the words "Planar 1:4.5 $F =$ .... mm" faces the focusing screen and the end inscribed "Series I^a, No. ...." points in the direction of the object to be reduced; with Nos. 6 to 18 this precaution is unnecessary.

Reproductions (Autotype, Three Colour Printing, Half-tone, Photogravure). Nos. 15 to 18 are available for these purposes, No. 15 covering a plate 24 × 30 cm ($9^3/_8 \times 11^3/_4$ in.), No. 18 one of 60 × 70 cm ($23^5/_8 \times 27^5/_8$ in.). We are prepared to supply, to order and at special rates, Planars capable of covering larger plates, or having some other special feature, with or without reduced secondary spectrum. — When working with these lenses, the following rules should be observed: Object, objective and focusing screen should be well adjusted with respect to each other, and the axis of the objective should be accurately at right angles to the focusing screen. Any faults in these adjustments are rendered apparent, in the shape of unsymmetrical definition, more readily than with the lenses hitherto used. This is due to the fact that the Planars work at considerably larger aperture than the latter, in which inaccuracies are to a certain extent covered by their greater depth of focus.

Focusing must be done with the most scrupulous care. When copying engravings it is advisable to follow the old plan of determining the best position of the screen by a series of trials. — Half-tones are copied with a stop of $^1/_9$ to $^1/_6$, engravings with stops of $^1/_{10}$ to $^1/_{18}$. Compared with the older lenses, the Planars require therefore, generally speaking, only $^1/_8$ of the time of exposure necessitated by the former.

If objectives are required for some special purpose with relative apertures other than those specified under Series I^a, we are prepared to supply them upon receipt of definite orders, and the prices will be governed in such cases by the diameter and focus of the lenses.

For Three Colour Printing and delicate Photo-gravure work we can recommend our Planars with reduced secondary spectrum as absolutely the best objectives now obtainable, although the difficulty and expense of procuring a supply of a special quality of glass render them necessarily more expensive than Planars made of ordinary materials.

Series I^{b}.

THE UNAR

Patent applied for.
Reg$^{d.}$ No. 41 716. 1899.

Franz Kühn, Berlin phot.

The Unar forms a connecting link between the Planar and our earliest Anastigmatic Objectives (the Protars) covered by our German Patent No. 56 109. The Planar, with its very great rapidity (relative aperture 1 : 3.6) and its remarkably good spherical and anastigmatic correction, constitutes a special objective for the most rapid exposures, enlargements and reproductions. But the requirements as regards aperture, good spherical correction and flatness of field are so exacting, that, to meet them, the Planar is of necessity of somewhat bulky make and, hence, can be less well recommended for general purposes. On the other hand, although the Protars stand in the first rank as regards handiness and general utility, they leave something to be desired in respect of aperture — even if recourse be had to constructions involving 5, 6 or 8 lenses — in circumstances where very rapid work is necessary under unfavourable conditions of lighting.

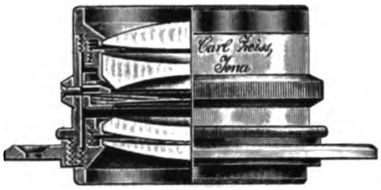
The Unar fills this gap and supplies the Amateur and Professional Photographer with an objective which is remarkably simple in its construction and yet possesses large aperture, coupled with flatness of field of great angular extent.

The Unar, Series I^{b}, contains only four separated lenses of the best Jena glass. At present we make eight sizes (numbered from 3 to 10), which have a relative aperture of 1 : 4.5 to 1 : 5.6 and an angle of view exceeding 65°. The number of component lenses being small, we are in a position to offer the objectives of this series at a comparatively low price.

The Unar can be specially recommended for Hand Cameras for the most rapid snapshots, also for portraits and groups, as well as for landscapes.

THE UNAR

in Standard Mount with Iris-Diaphragm.



Series and	The Unar in Standard Mount		Diameter of Lenses		Equivalent Focus		Extension		Largest relative Aperture	Available angle	Size of Plate covered with				Diameter of image with small stops		Standard Mount
											full aperture		intermediate stops				
No.	Code-word	Price $	mm	in.	mm	in.	mm	in.	1 :	Degrees	cm	in.	cm	in.	cm	in.	No.
I^b, 3	**Undine**	**31.50**	25	1	112	4 3/8	100	4	4.5	65	6×9	2 3/8 × 3 1/2	8×10	3 1/8 × 4	19	7 1/2	III
I^b, 4	**Ungko**	**38.50**	31	1 1/4	136	5 3/8	124	4 7/8	4.5	65	8×10	3 1/8 × 4	9×12	3 1/2 × 4 3/4	21	8 1/4	IV_2
I^b, 5	**Ungvar**	**42.—**	31	1 1/4	155	6	143	5 5/8	5	65	9×12	3 1/2 × 4 3/4	12×15	4 3/4 × 6	26	10 1/4	IV_2
I^b, 6	**Unimak**	**63.—**	42	1 5/8	210	8 1/4	191	7 1/2	5	65	12×16	4 3/4 × 6 1/2	13×18	5 1/8 × 7	34	13 3/8	VII
I^b, 7	**Unit**	**90.50**	51	2	255	10	232	9 1/8	5	65	13×18	5 1/8 × 7	16×21	6 1/2 × 8 1/4	40	15 3/4	X_2
I^b, 8	**Univers**	**125.50**	61	2 3/8	305	12	274	10 3/4	5	65	16×21	6 1/2 × 8 1/4	18×24	7 × 9 1/2	48	18 7/8	XII_2
I^b, 9	**Unpro**	**164.—**	71	2 3/4	375	14 3/4	327	13	5.3	65	18×24	7 × 9 1/2	21×26	8 1/4 × 10 1/4	59	23 1/8	XIII
I^b, 10	**Unze**	**209.—**	82	3 1/4	460	18	411	16 1/4	5.6	65	21×26	8 1/4 × 10 1/4	30×40	11 3/4 × 15 3/4	73	28 5/8	XIV

When ordering by wire it is sufficient to quote the ***Code-word.***

By ***"Extension"*** *is understood the distance of the sharp picture from the face of the camera front when focused for very distant objects.*

The halves of the Unar (front and back lens resp.) are not corrected separately as objectives.

In view of the French Patent Laws the objectives of Series I^b must not be introduced into France by way of trade.

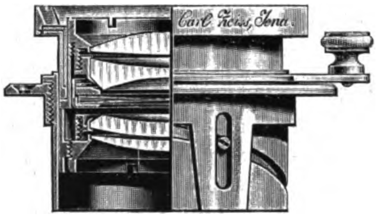
Franz Kühn, Berlin phot.

For Hand Cameras with fixed extension, in which the shutter works either directly in front of the sensitive plate or directly behind the objective, we recommend the **smaller sizes** of

THE UNAR

in Special Mount A with

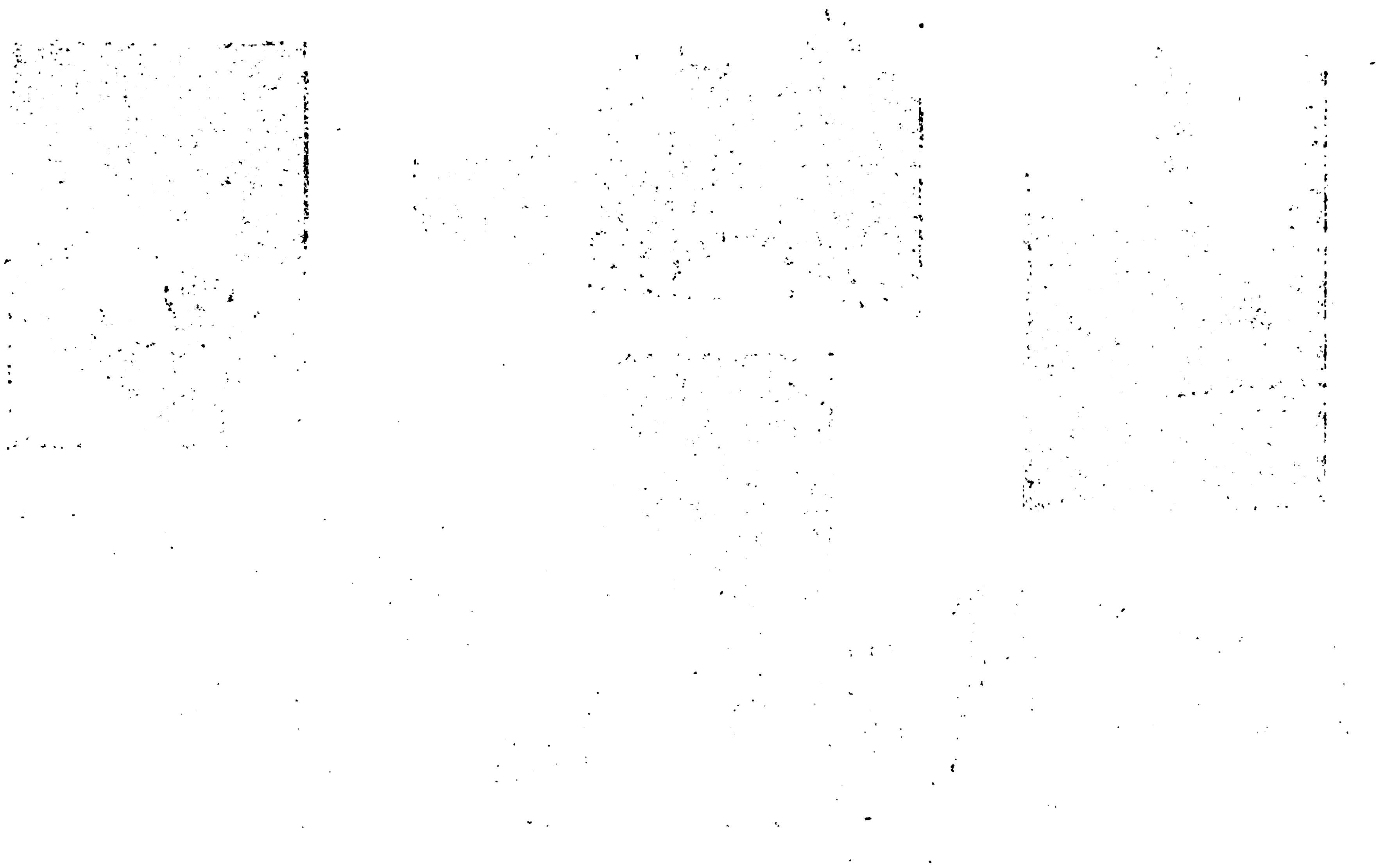
Iris-Diaphragm and Focusing Attachment.



Series and No.	The Unar in Special Mount A		Diameter of Lenses		Equivalent Focus		Extension		Size of Plate covered				Special Mount
	Code-word	Price $	mm	in.	mm	in.	mm	in.	from cm	from in.	to cm	to in.	No.
I^b, 3	**Uspal**	**35.—**	25	1	112	$4^3/_8$	119	$4^3/_4$	6×9	$2^3/_8 \times 3^1/_2$	8×10	$3^1/_8 \times 4$	*A* III
I^b, 4	**Uspafa**	**42.50**	31	$1^1/_4$	136	$5^3/_8$	142	$5^1/_2$	8×10	$3^1/_8 \times 4$	9×12	$3^1/_2 \times 4^3/_4$	*A* IV$_2$
I^b, 5	**Usperial**	**46.—**	31	$1^1/_4$	155	6	161	$6^3/_8$	9×12	$3^1/_2 \times 4^3/_4$	12×16	$4^3/_4 \times 6^1/_2$	*A* IV$_2$

*By “**Extension**” is understood the distance fo the sharp picture from the face of the camera front when focused for very distant objects.*

Objectives in Special Mount A cannot be used in conjunction with Hand Cameras where the shutter works between the lenses of the objective.



[illegible]
TAKEN WITH UNAR 1:4,5 F:112 mm.

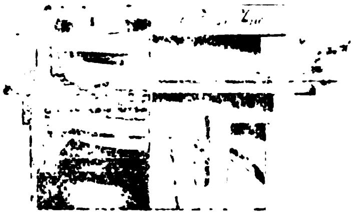
Carl Zeiss optische Werkstaette
JENA

For Hand Cameras [illegible] extension,

[illegible] shutter works either [illegible] the sensitive plate or directly behind the objective we recommend [illegible] **smaller sizes** [illegible]

THE [illegible]

in S[illegible] with



from | to | Spec[illegible]

cm | in

[illegible] IV$_2$

[illegible] IV$_2$

[illegible] distance to the sharp picture [illegible] ed for very distant objects

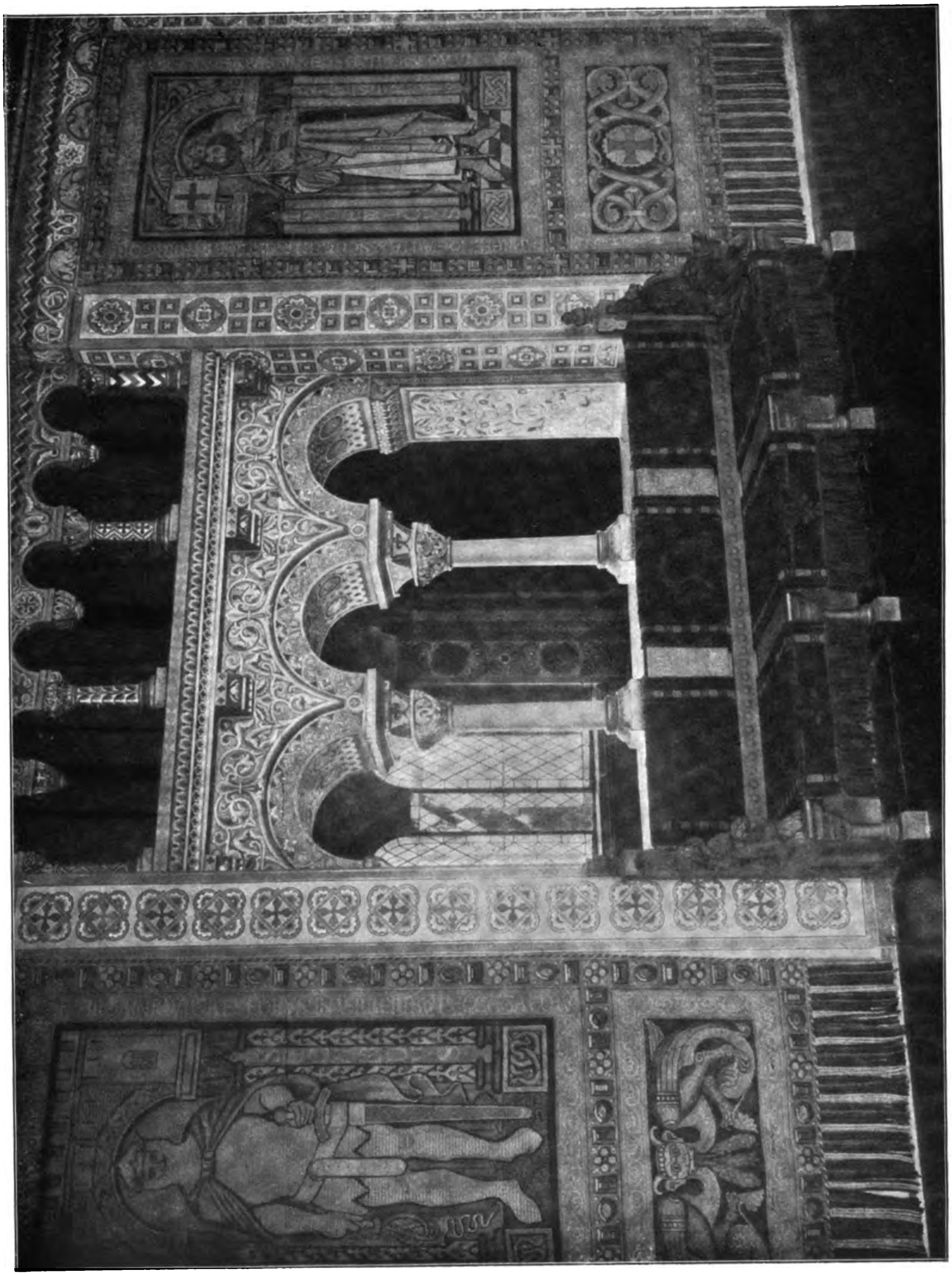
[illegible]ount A cannot be used [illegible] con-[illegible] ras where the shutter works between

Dr. P. Rudolph Jena phot.

Georg Büxenstein & Comp. Berlin, hel.

REPRODUCTION OF VIEWS 6 × 9 cm.
TAKEN WITH UNAR 1:4.5 F = 112 mm

Carl Zeiss optische Werkstaette
JENA



Interior View of the Wartburg, Eisenach.

Carl Zeiss, Optische Werkstaette, Jena.

Paris Exhibition 1900.

For Snap-shots

with small plates we recommend

Unars

No. 3, $f = 112$ mm ($4^3/_8$ inches)
for plates measuring from **6 × 9** to 8 × 10 cm,
($2^3/_8 \times 3^1/_2$ to $3^1/_8 \times 4$ in.)

No. 4, $f = 136$ mm ($5^3/_8$ inches)
for plates measuring from 8 × 10 to **9 × 12** cm,
($3^1/_8 \times 4$ to $3^1/_2 \times 4^3/_4$ in.)

No. 5, $f = 155$ mm (6 inches)
for plates measuring from 9 × 12 to **12 × 15** cm
($3^1/_2 \times 4^3/_4$ to $4^3/_4 \times 6$ in.).

For Portraits

Nos. 6, 7, 8, 9 and 10 are most suitable, viz:

Unar	1:5	$f = 210$	mm	($8^1/_4$ in.)	for cartes de Visite,	full length:
Unar	1:5	$f = 255$	„	(10 in.)	„ „	$^1/_3$ length (Bust),
Unar	1:5	$f = 305$	„	(12 in.)	„ Cabinets	$^1/_3$ length (Bust),
Unar	1:5.3	$f = 375$	„	($14^3/_4$ in.)	„ „	$^1/_2$ „ (Demies),
Unar	1:5.6	$f = 460$	„	(18 in.)	„ Boudoir	$^1/_2$ „ „

For taking Groups

we recommend

Unar	1:5	$f=210$ mm	($8^1/_4$ in.)	for plates from	12×16	to 13×18 cm	($4^3/_4 \times 6^1/_2$	to $5^1/_8 \times 7$ in.),
Unar	1:5	$f=255$ „	(10 in.)	„ „ „	13×18	„ 16×21	„ ($5^1/_8 \times 7$	„ $6^1/_2 \times 8^1/_4$ „),
Unar	1:5	$f=305$ „	(12 in.)	„ „ „	16×21	„ 18×24	„ ($6^1/_2 \times 8^1/_4$	„ $7 \times 9^1/_2$ „),
Unar	1:5.3	$f=375$ „	($14^3/_4$)	„ „ „	18×24	„ 21×26	„ ($7 \times 9^1/_2$	„ $8^1/_4 \times 10^1/_4$ „),
Unar	1:5.6	$f=460$ „	(18 in.)	„ „ „	24×30	„ 28×36	„ ($9^1/_2 \times 11^3/_4$	„ $11 \times 14^1/_8$ „).

With **landscape work** it should be remembered that it is advisable to select an objective with sufficient focal length, so that distant objects may not be too greatly reduced in proportion.

Series IIa.

PROTAR 1:8.

Regd. under German Patent No. 56109.

The Protar 1:8 possesses a relative aperture of 1:8 and a field of 75°. On account of its particularly good spherical correction it can be strongly recommended for photographing **plane objects,** at comparatively wide apertures, with extreme sharpness.

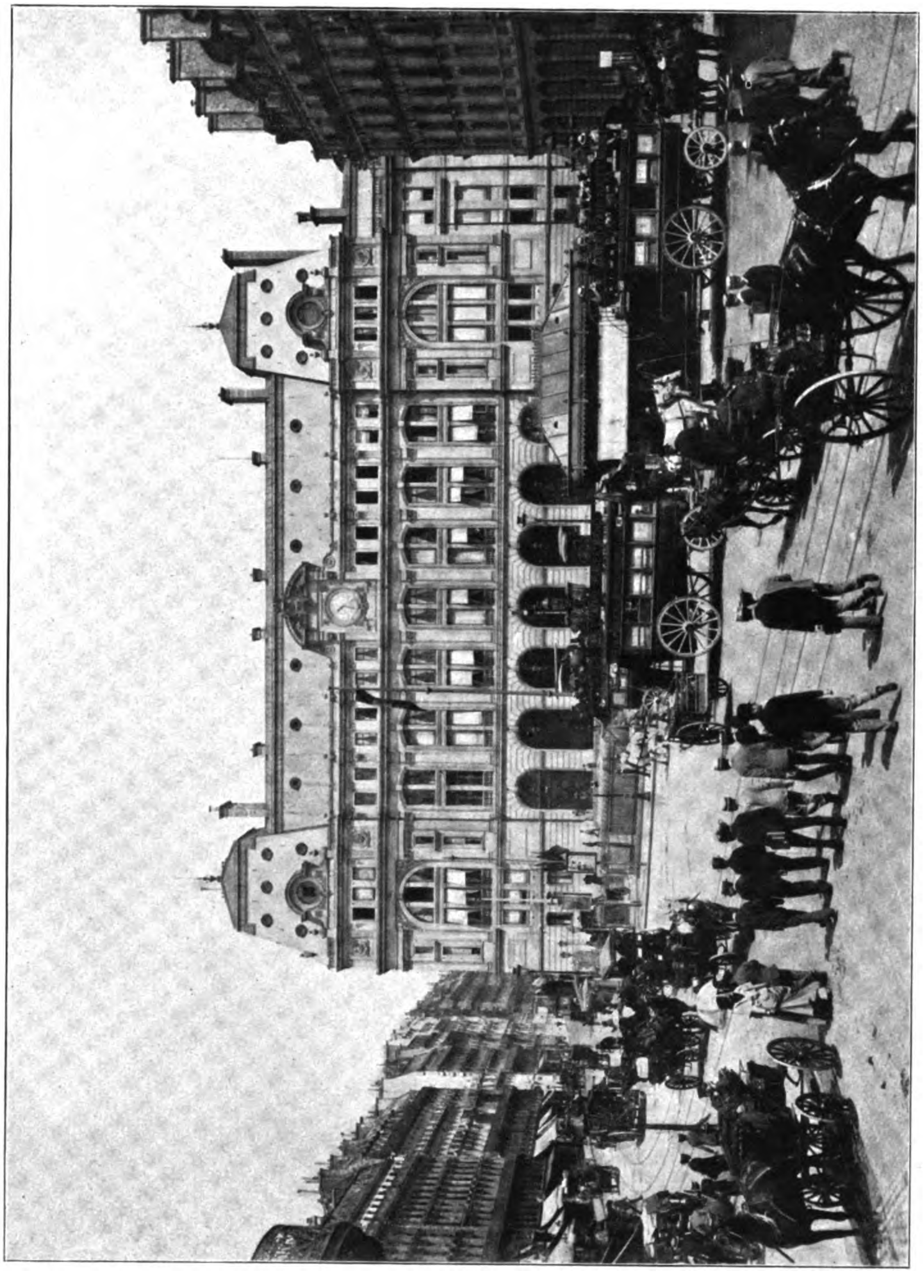
Of the various sizes of objectives specified in the annexed table those with foci of 110 and 136 mm ($4^1/_4$ and $5^3/_8$ in.) have been extensively adopted for **hand cameras,** covering plates from 6 × 9 to 9 × 12 cm ($2^3/_8 \times 3^1/_2$ to $3^1/_2 \times 4^3/_4$ in.). They are also largely used for preparing **stereoscopic views.**

Objectives with $f = 205$ mm (8 in.), covering plates 13 × 18 cm ($5^1/_8 \times 7$ in.), or those with $f = 295$ mm ($11^1/_2$ in.), plates 18 × 24 cm ($7 \times 9^1/_2$ in.), are generally in favour for **stand cameras** so as to be equipped with a suitable outfit for instantaneous photography as well as for the taking of groups and landscape views.

The lenses $f = 350$ and 433 mm ($13^3/_4$ and 17 in.), shown on the list as Nos. 7 and 8, are adapted for large **groups, portraits** and **reproductions** up to dimensions of 40 × 50 cm ($15^3/_4 \times 19^1/_2$ in.).

The smaller sizes of this series are suitable for **enlargements** (not greater than 6 ×) and projections. The selection must be governed by the size of the original and the dimensions of the enlarging apparatus available.

For the preparation of stereoscopic views and similar purposes pairs of objectives of strictly **similar focus, and requiring the same camera extension and the same amount of stopping,** are supplied to order, at an extra cost of 3.— $ per pair.

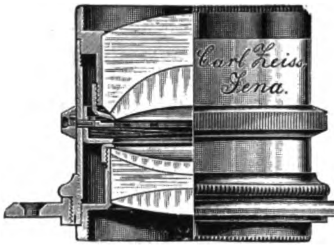


Street-scene, Paris.

Carl Zeiss, Optische Werkstaette, Jena.

PROTAR 1:8

in Standard Mount with Iris-Diaphragm.

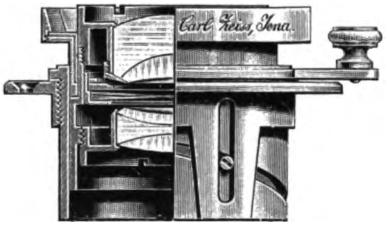


Series and No.	Protar 1:8 in Standard Mount Code-word	Price $	Diameter of Lenses mm	Diameter of Lenses in.	Equivalent Focus mm	Equivalent Focus in.	Extension mm	Extension in.	Size of Plate covered at 1:8 cm	Size of Plate covered at 1:8 in.	Size of Plate covered at 1:12.5 cm	Size of Plate covered at 1:12.5 in.	Diameter of sharp image with small stops ∢ 75° cm	Diameter of sharp image with small stops ∢ 75° in.	Standard Mount No.
II^a, 0	**Cabale**	**29.50**	13	½	90	3½	84	3⅜	6×6	2⅜× 2⅜	8× 8	3⅛× 3⅛	13	5⅛	I
II^a, 1	**Cab**	**29.50**	16	⅝	110	4¼	99	4	6×8	2⅜× 3⅛	9×12	3½× 4¾	17	6¾	II
II^a, 2	**Cacao**	**33.—**	19.5	¾	136	5⅜	122	4¾	9×12	3½× 4¾	12×15	4¾× 6	21	8¼	II
II^a, 3	**Codet**	**43.50**	25	1	167	6½	150	6	12×15	4¾× 6	13×18	5⅛× 7	26	10¼	III
II^a, 4	**Canon**	**54.—**	31	1¼	205	8	180	7	13×18	5⅛× 7	16×21	6½× 8¼	32	12½	IV$_1$
II^a, 5	**Cascade**	**64.50**	36	1½	244	9⅝	218	8⅝	13×21	5⅛× 8¼	18×24	7 × 9½	37	14½	V
II^a, 6	**Centaur**	**85.50**	42	1⅝	295	11½	263	10⅜	18×24	7 × 9½	24×30	9½×11¾	45	17⅝	VI
II^a, 7	**Ceres**	**125.50**	51.5	2	350	13¾	311	12¼	21×27	8¼×10⅝	26×34	10¼×13⅜	54	21¼	IX$_1$
II^a, 8	**Codex**	**160.50**	61	2⅜	433	17	385	15⅛	24×30	9½×11¾	33×44	13 ×17¼	67	26⅜	XI

For **Hand Cameras** with fixed extension and focal plane shutter working in front of the sensitive plate we recommend

PROTAR 1:8

in Special Mount A with Iris-Diaphragm and Focusing Attachment.



Series and No.	Protar 1:8 in Special Mount A Code-word	Price $	Diameter of Lenses mm	Diameter of Lenses in.	Equivalent Focus mm	Equivalent Focus in.	Extension mm	Extension in.	Size of Plate covered from cm	Size of Plate covered from in.	Size of Plate covered to cm	Size of Plate covered to in.	Special Mount No.
II^a, 0	**Cabalial**	**33.—**	13	½	90	3½	90	3½	5× 6	2 ×2⅜	6× 9	2⅜×3½	*A* II
II^a, 1	**Cabial**	**33.—**	16	⅝	110	4¼	110	4¼	6× 6	2⅜×2⅜	8×10	3⅛×4	*A* II
II^a, 2	**Cacaol**	**36.50**	19.5	¾	136	5⅜	136	5⅜	8×10	3⅛×4	9×12	3½×4¾	*A* II
II^a, 3	**Cadetial**	**47.—**	25	1	167	6½	167	6½	9×12	3½×4¾	12×15	4¾×6	*A* III
II^a, 4	**Canonial**	**59.50**	31	1¼	205	8	205	8	12×15	4¾×6	13×18	5⅛×7	*A* IV$_1$
II^a, 5	**Cascadial**	**70.—**	36	1½	244	9⅝	244	9⅝	13×18	5⅛×7	15×21	5⅛×8¼	*A* V

When ordering by wire it is sufficient to quote the ***Code-word.***

*By “**Extension**” is understood the distance of the sharp image from the face of the camera front when focused for very distant objects.*

Series III^{a}.

PROTAR 1:9.

Patented at home and abroad.

Reg$^{\underline{d}}$ No. 41 715 — 1899.

These objectives have an anastigmatically flat field; their angle is about 97°, and the aperture of the objective is 1:9.

Protar 1:9 is therefore an **instantaneous** and, at the same time, a **wide-angle lens.**

The smaller objectives of this series are particularly well adapted for **stereoscopic** and **hand cameras.** They are also much appreciated as wide-angle lenses for landscapes, interiors and architectural views.

As a suitable outfit for **hand cameras** we would suggest the following:

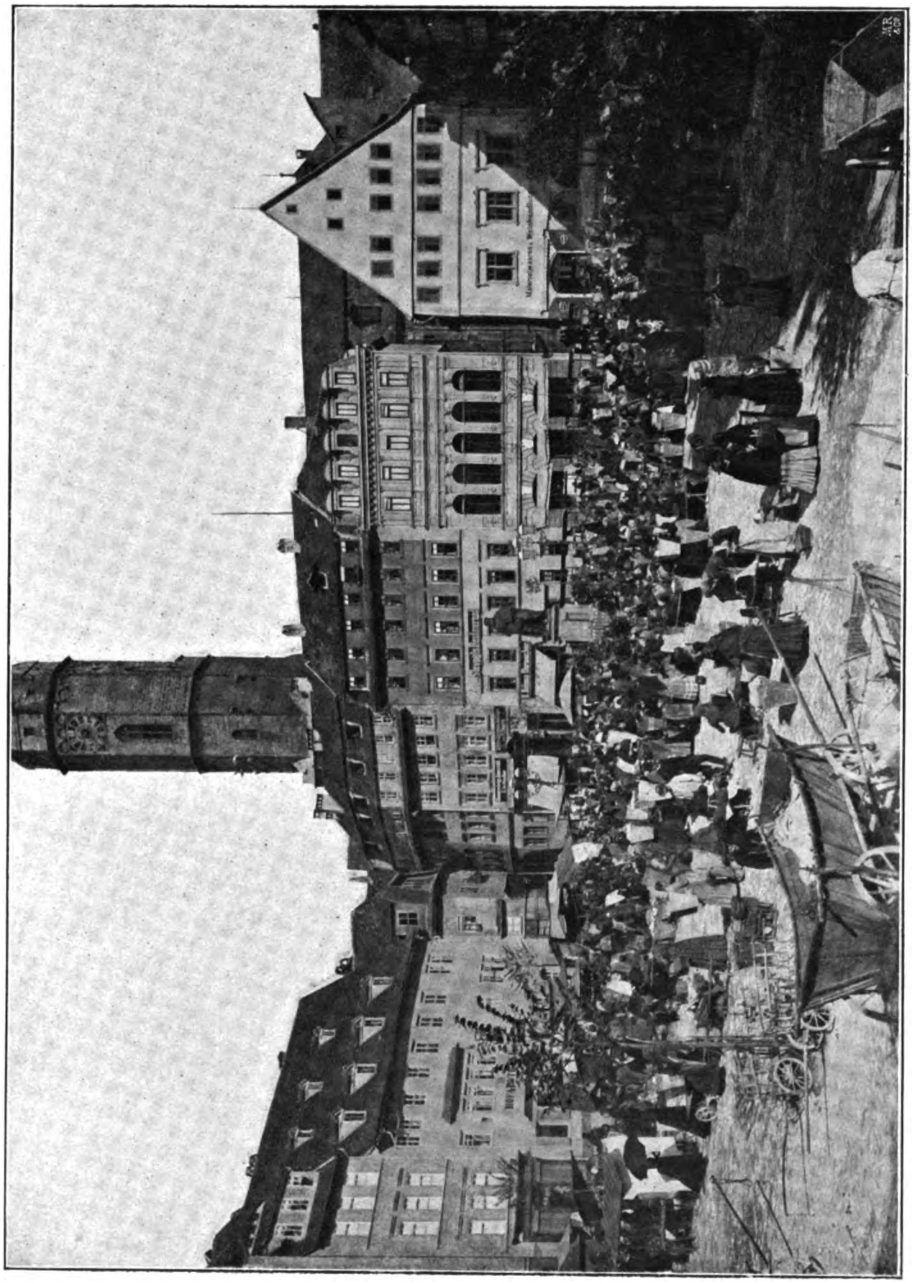
Size of Plate	Focus of Lens
6 × 9 cm ($2^{3}/_{8}$ × $3^{1}/_{2}$ in.)	95 mm ($3^{3}/_{4}$ in.)
9 × 12 „ ($3^{1}/_{2}$ × $4^{3}/_{4}$ in.)	120 or 150 „ ($4^{3}/_{4}$ or 6 in.)
13 × 18 „ ($5^{1}/_{8}$ × 7 in.)	172 or 196 „ ($6^{3}/_{4}$ or $7^{3}/_{4}$ in.).

For **Stand Cameras** we recommend:

Size of Plate	Focus of Lens
13 × 18 cm ($5^{1}/_{8}$ × 7 in.)	172 or 196 mm ($6^{3}/_{4}$ or $7^{3}/_{4}$ in.)
18 × 24 „ (7 × $9^{1}/_{2}$ in.)	272 or 317 „ ($10^{3}/_{4}$ or $12^{5}/_{8}$ in.).

The larger lenses of Series III^{a} are eminently suitable for **large portraits, large groups,** and **reproductions.**

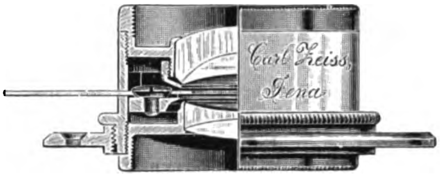
Our pamphlet „Anleitung und Tabellen", which we shall be glad to supply gratis and postfree, may be a welcome guide to both amateur and professional photographers in the selection of suitable lenses and will, in most cases, be found to contain all the advice desired. We are also prepared to meet the wants of individual customers who wish to procure a special objective for copying relief or plane objects. Special estimates will be submitted on receipt of detailed instructions.



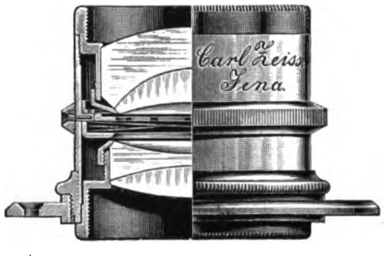
Market Place, Jena.

Carl Zeiss, Optische Werkstaette, Jena.

PROTAR 1:9



in Standard Mount with Rotating Diaphragm,



with Iris-Diaphragm.

Series and No.	Protar 1:9 in Standard Mount Code-word	Price $	Diameter of Lenses mm	in.	Equivalent Focus mm	in.	Extension mm	in.	Size of Plate covered at 1 : 9 cm	in.	1 : 12.5 cm	in.	Diameter of sharp image with small stops ∢ 90° cm	in.	Standard Mount No.
III^a, 0	**Gala**	**21.—***	10.5	3/8	75	3	68	2 3/4	6 × 6	2 3/8 × 2 3/8	6 × 8	2 3/8 × 3 1/8	15	6	I
III^a, 00	**Galeere**	**21.—***	13	1/2	95	3 3/4	86	3 3/8	8 × 8	3 1/8 × 3 1/8	8 × 10	3 1/8 × 4	19	7 1/2	II
III^a, 1	**Galone**	**23.—***	16	5/8	120	4 3/4	110	4 3/8	8 × 10	3 1/8 × 4	9 × 12	3 1/2 × 4 3/4	24	9 1/2	
III^a, 2	**Gamma**	**26.—***	19.5	3/4	150	6	138	5 1/2	9 × 12	3 1/2 × 4 3/4	12 × 15	4 3/4 × 6	30	11 3/4	
III^a, 3	**Gardine**	**31.50**	22.5	7/8	172	6 3/4	157	6 1/8	12 × 15	4 3/4 × 6	13 × 18	5 1/8 × 7	34	13 3/8	III
III^a, 4	**Garter**	**35.—**	25	1	196	7 3/4	181	7 1/8	13 × 18	5 1/8 × 7	13 × 21	5 1/8 × 8 1/4	39	15 3/8	
III^a, 5	**Gazelle**	**45.50**	31	1 1/4	230	8 1/2	206	8	13 × 21	5 1/8 × 8 1/4	16 × 21	6 1/2 × 8 1/4	46	18	IV$_1$
III^a, 6	**Genius**	**56.—**	36	1 1/2	272	10 3/4	246	9 3/4	16 × 21	6 1/2 × 8 1/4	18 × 24	7 × 9 1/2	54	21 1/4	V
III^a, 7	**Gilde**	**70.—**	42	1 5/8	317	12 7/16	292	11 1/2	18 × 24	7 × 9 1/2	21 × 27	8 1/4 × 10 5/8	63	24 3/4	VII
III^a, 8	**Giraffe**	**104.50**	51.5	2	407	16	376	14 3/4	21 × 27	8 1/4 × 10 5/8	24 × 30	9 1/2 × 11 3/4	81	31 3/4	IX$_1$
III^a, 9	**Gloria**	**139.50**	61	2 3/8	505	19 3/4	467	18 3/8	24 × 30	9 1/2 × 11 3/4	27 × 34	10 5/8 × 13 3/8	101	39 5/8	XI
III^a, 10	**Gnom**	**174.50**	71	2 3/4	600	23 1/2	555	22	27 × 34	10 5/8 × 13 3/8	30 × 40	11 3/4 × 15 3/4	120	47 1/8	XII$_1$
III^a, 11	**Gondel**	**226.50**	82	3 1/4	690	27	638	25 1/8	30 × 40	11 3/4 × 15 3/4	34 × 45	13 3/8 × 17 5/8	138	54 1/4	XIV
III^a, 12	**Gral**	**279.—**	94	3 5/8	820	32 1/4	759	29 7/8	34 × 45	13 3/8 × 17 5/8	40 × 50	15 3/4 × 19 5/8	164	64 3/8	XV

**** These objectives — Nos. 0 to 2 — are, as a rule, supplied with rotating diaphragms, which are better adapted than the iris-diaphragms for obtaining exactly similar apertures in both objectives of a stereoscopic pair.***

For the preparation of stereoscopic views and similar purposes pairs of objectives of strictly **similar focus, and requiring the same camera extension and the same amount of stopping,** are supplied to order, at an extra cost of 3.— $ per pair.

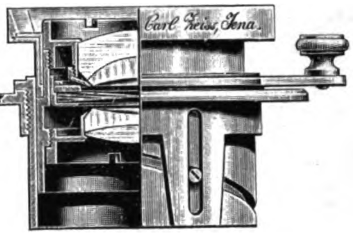
To obviate deterioration of any good objective during continued use, the exposed surfaces of the lenses, and those within the mount, should occasionally be freed from dust and dirt. This should, of course, be done with the utmost care, clean soft linen being best adapted for this purpose.

For **Hand Cameras** with fixed extension and focal plane shutter working in front of the sensitive plate we recommend

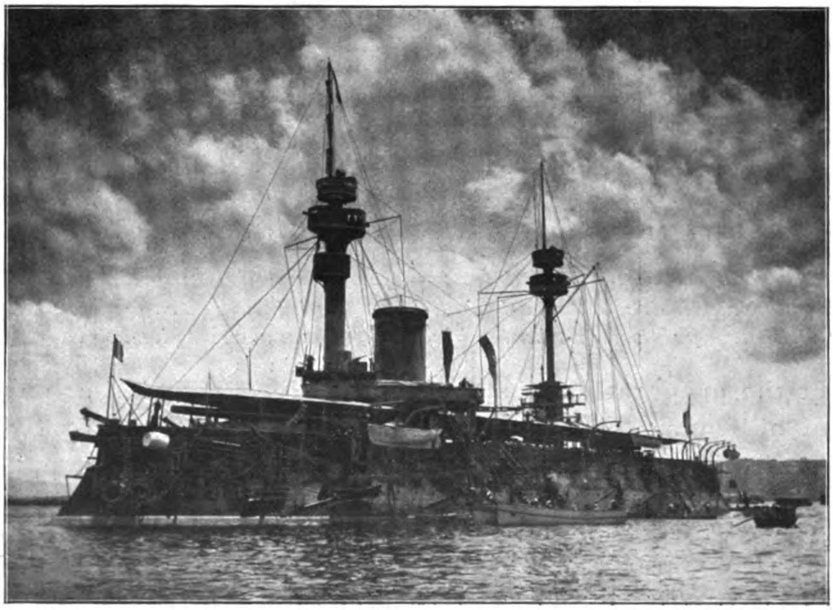
PROTAR 1:9

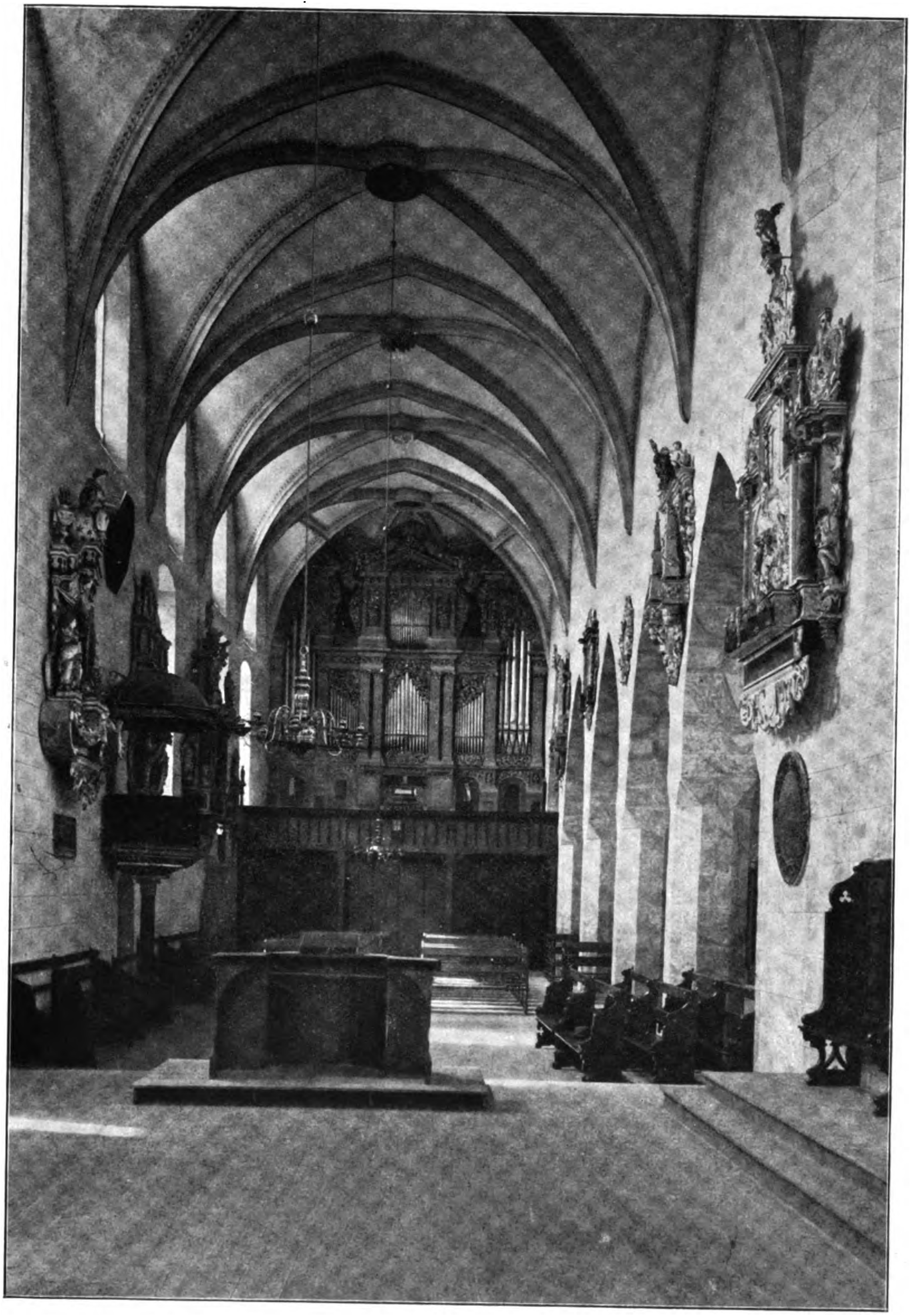
in Special Mount A with

Iris-Diaphragm and Focusing Attachment.



Series and No.	Protar 1:9 in Special Mount A Code-word	Price $	Diameter of Lenses mm	 in.	Equivalent Focus mm	 in.	Extension mm	 in.	Size of Plate covered from cm	 in.	 to cm	 in.	Special Mount No.
III^a, 00	**Galeerial**	**24.50**	13	$\frac{1}{2}$	95	$3\frac{3}{4}$	98	$3\frac{7}{8}$	6 × 9	$2\frac{3}{8} \times 3\frac{1}{2}$	8 × 10	$3\frac{1}{8} \times 4$	*A* II
III^a, 1	**Galonial**	**26.—**	13	$\frac{1}{2}$	120	$4\frac{3}{4}$	121	$4\frac{3}{4}$	8 × 10	$3\frac{1}{8} \times 4$	9 × 12	$3\frac{1}{2} \times 4\frac{3}{4}$	*A* II
III^a, 2	**Gammial**	**29.50**	19.5	$\frac{3}{4}$	150	6	150	6	9 × 12	$3\frac{1}{2} \times 4\frac{3}{4}$	12 × 15	$4\frac{3}{4} \times 6$	*A* II
III^a, 3	**Gardinial**	**35.—**	22.5	$\frac{7}{8}$	172	$6\frac{3}{4}$	175	$6\frac{7}{8}$	12 × 15	$4\frac{3}{4} \times 6$	13 × 18	$5\frac{1}{8} \times 7$	*A* III
III^a, 4	**Gartial**	**38.50**	25	1	196	$7\frac{3}{4}$	198	$7\frac{3}{4}$	13 × 18	$5\frac{1}{8} \times 7$	13 × 21	$5\frac{1}{8} \times 8\frac{1}{4}$	*A* III
III^a, 5	**Gazellial**	**50.50**	31	$1\frac{1}{4}$	230	$8\frac{1}{2}$	230	$8\frac{1}{2}$	13 × 21	$5\frac{1}{8} \times 8\frac{1}{4}$	16 × 21	$6\frac{1}{2} \times 8\frac{1}{4}$	*A* IV$_1$
III^a, 6	**Genial**	**61.—**	36	$1\frac{1}{2}$	272	$10\frac{3}{4}$	282	11	16 × 21	$6\frac{1}{2} \times 8\frac{1}{4}$	18 × 24	$7 \times 9\frac{1}{2}$	*A* V





College Church, Jena.

Carl Zeiss, Optische Werkstaette, Jena.

Series V.

PROTAR 1:18.

A Wide-angle Lens for Architecture, Interiors and Photogrammetric Work, also for Copying.

The small numbers of Protar 1 : 18 (incl. 390 mm [= $15^3/_8$ in.] focus) embrace an angle of over 110°, and are therefore wide-angle lenses in the fullest sense of the term. Their aperture 1:18 renders them sufficiently rapid for nearly all kinds of outdoor instantaneous photography with sunlight, whilst their orthoscopically excellent definition fits them equally well for photogrammetric purposes also.

For wide-angle views proper it will generally be found that the stand camera will answer best. In order to guard against disturbing causes affecting the perspective care should be taken that the bottom of the camera is perfectly horizontal and that focusing screen and camera front are parallel to each other and strictly perpendicular to the former. Objective No. 2 is best adapted for plates measuring 13 × 18 cm ($5^1/_8$ × 7 in.), Nos. 3 or 4 for plates measuring 18 × 24 cm (7 × $9^1/_2$ in.), No. 5 for plates measuring 24 × 30 cm ($9^1/_2$ × $11^3/_4$ in.).

The larger lenses of this series (those from 460 mm [= 18 in.] focus upward) have a field of about 90°, and are particularly well adapted for copying. Within the limits of 60° the field possesses a satisfactory degree of anastigmatic flatness.

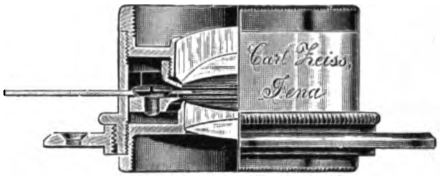
Our pamphlet "Anleitung und Tabellen", which we shall be glad to supply gratis and postfree, may be a welcome guide to both amateur and professional photographers in the selection of suitable lenses and will, in most cases, be found to contain all the advice desired. ***We are also prepared to meet the wants of individual customers who wish to procure a special objective for copying relief on plane objects. Special estimates will be submitted on receipt of detailed instructions.***

To obviate deterioration of any good objective during continued use, the exposed surfaces of the lenses, and those within the mount, should occasionally be freed from dust and dirt. This should, of course, be done with the utmost care, clean soft linen being best adapted for this purpose.

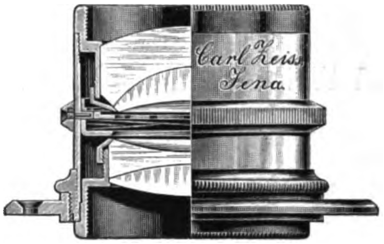
Carl Zeiss, Optische Werkstaette, Jena.

PROTAR 1:18

in Standard Mount with Rotating Diaphragm,



in Standard Mount with Iris-Diaphragm.



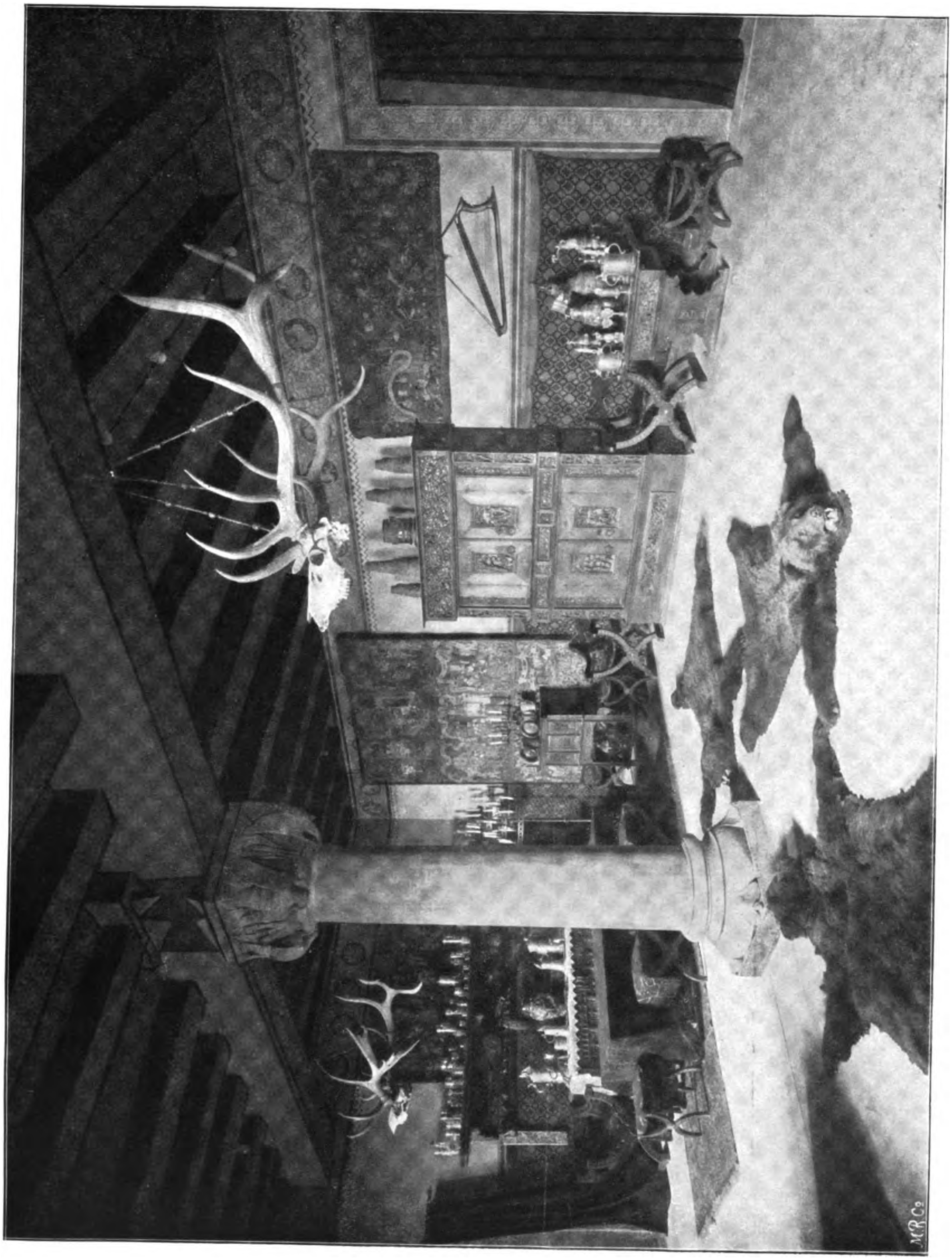
Series and No.	Protar 1:18 in Standard Mount Code-word	Protar 1:18 in Standard Mount Price $	Diameter of Lenses mm	Diameter of Lenses in.	Equivalent Focus mm	Equivalent Focus in.	Extension mm	Extension in.	Size of Plate covered at 1:18 cm	Size of Plate covered at 1:18 in.	Size of Plate covered at 1:36 cm	Size of Plate covered at 1:36 in.	Diameter of the sharp field with small stops cm	Diameter of the sharp field with small stops in.	Standard Mount No.
V, 0	**Laban**	**22.50***	3.5	1/8	40	1 9/16	35	1 3/8	4.5 × 6	1 3/4 × 2 3/8	6 × 8	2 3/8 × 3 1/8	10.5	4 1/8	0
V, 00	**Labe**	**22.50***	5	3/16	62	2 7/16	56	2 3/16	6 × 8	2 3/8 × 3 1/8	8 × 10	3 1/8 × 4	14.5	5 11/16	0
V, 1	**Labrador**	**22 50***	7.5	5/16	86	3 3/8	79	3 1/8	9 × 12	3 1/2 × 4 3/4	12 × 15	4 3/4 × 6	22	8 5/8	I
V, 2	**Lagune**	**22.50***	9.5	3/8	112	4 7/16	104	4	12 × 15	4 3/4 × 6	13 × 18	5 1/8 × 7	28	11	I
V, 3	**Lama**	**28.—***	12	1/2	141	5 1/2	132	5 3/16	13 × 18	5 1/8 × 7	16 × 21	6 1/2 × 8 1/4	36	14 1/8	II
V, 4	**Lapsus**	**35.—***	14.5	9/16	182	7 3/16	172	6 3/4	16 × 21	6 1/2 × 8 1/4	20 × 26	8 × 10 1/4	40	15 3/4	
V, 5	**Lateran**	**43.50**	17.5	11/16	212	8 3/8	202	7 7/8	20 × 26	8 × 10 1/4	24 × 30	9 1/2 × 11 3/4	54	21 1/4	
V, 6	**Lava**	**54.—**	20.5	13/16	265	10 1/2	253	10	24 × 30	9 1/2 × 11 3/4	26 × 35	10 1/4 × 13 3/4	68	26 3/4	
V, 7	**Lawine**	**64.50**	23.5	15/16	315	12 3/8	295	11 1/2	26 × 35	10 1/4 × 13 3/4	30 × 40	11 3/4 × 15 3/4	80	31 1/2	
V, 7a	**Leda**	**85.50**	26	1	390	15 3/8	367	14 7/16	30 × 40	11 3/4 × 15 3/4	40 × 50	15 3/4 × 19 5/8	85	33 3/8	III
V, 8	**Legende**	**85.50**	26	1	460	18	429	17	30 × 40	11 3/4 × 15 3/4	40 × 50	15 3/4 × 19 5/8	84	33	III
V, 9	**Legion**	**125.50**	35	1 3/8	632	24 3/4	596	23 3/8	40 × 50	15 3/4 × 19 5/8	60 × 70	23 1/2 × 27 1/2	116	45 1/2	VI
V, 10	**Leo**	**247.50**	54	2 1/8	947	37 1/4	896	35 1/4	50 × 60	19 5/8 × 23 1/2	80 × 90	31 1/2 × 35 3/8	173	68	X_1

Larger lenses than those specified are made to order only.

*By "**Extension**" is understood the distance of the sharp picture from the face of the camera front when focused for very distant objects.*

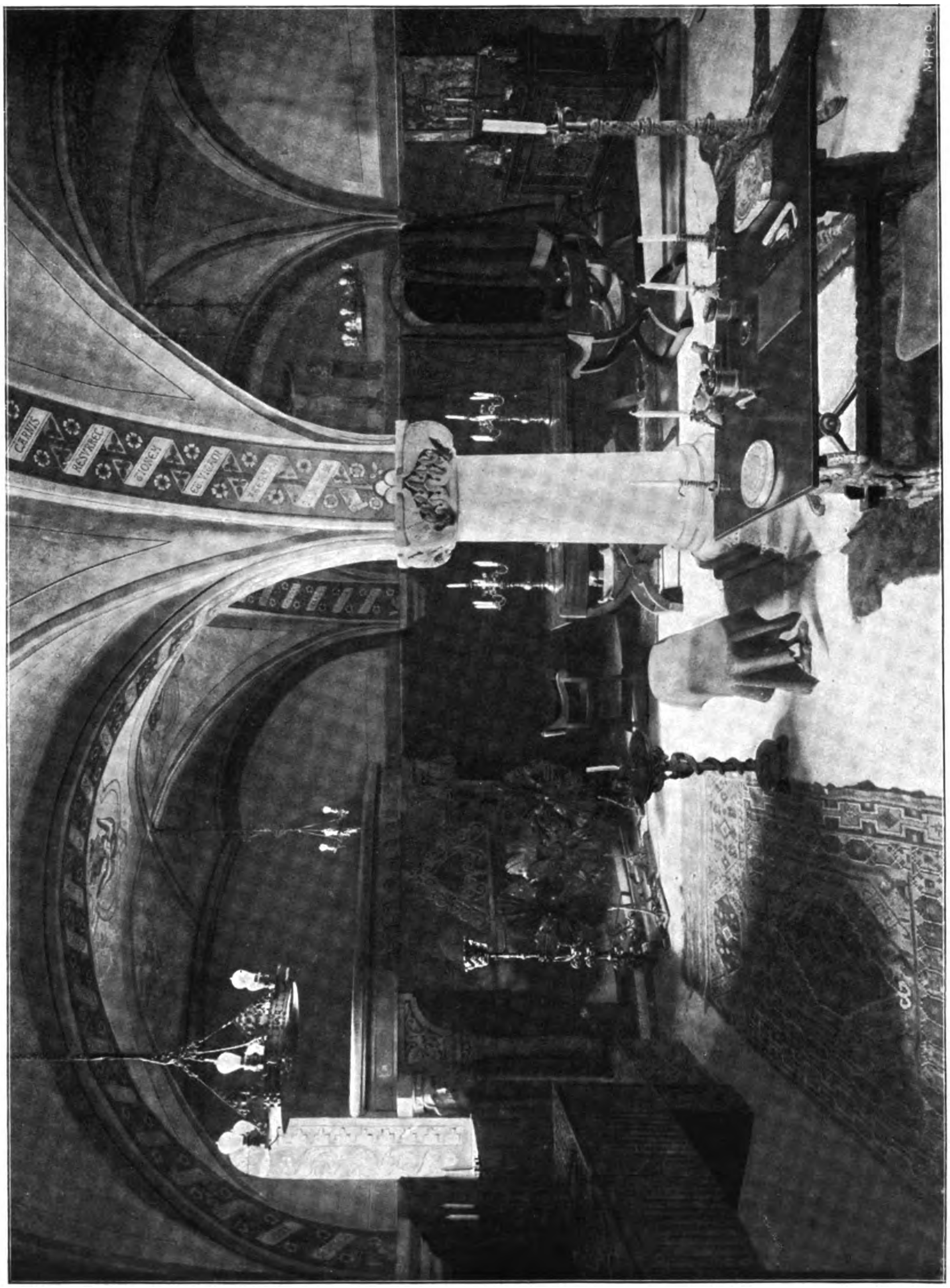
**** These objectives — Nos. 0 to 4 — are, as a rule, supplied with rotating diaphragms, which are better adapted than the iris-diaphragms for obtaining exactly similar apertures in both objectives of a stereoscopic pair.***

For the preparation of stereoscopic views and similar purposes pairs of objectives of strictly **similar focus, and requiring the same camera extension and the same amount of stopping,** are supplied to order, at an extra cost of 3.— $ per pair.



Interior of Wartburg, Eisenach.

Carl Zeiss, Optische Werkstaette, Jena.



Interior of Wartburg, Eisenach.

Carl Zeiss, Optische Werkstaette, Jena.

Series VII.

PROTAR-LENS.

Component Element of the Universal Objectives of Series VII^{a} and of Convertible Sets.

Nos. 0, 00 and 000 of this series have a relative aperture of 1:11 and an angle of about 75°; the larger numbers (from No. 1 upwards) have, however, a relative aperture of 1:25 and a field of about 85°.

The Protar-lens excels in anastigmatic flatness of field of a high order and is therefore particularly well adapted for wide-angle **instantaneous photography** outdoors under favourable conditions of light, also for **landscape views** and for **large portraits** and **groups.**

Like all landscape lenses, the Protar-lens, when used singly, slightly distorts marginal lines. This defect is, however, of no consequence except with wide angles. For instance, the amount of distortion produced by Objective No. 3, having a focus of 285 mm ($11^{1}/_{4}$ in.), on a plate measuring 13×18 cm ($5^{1}/_{8} \times 7$ in.) is scarcely noticeable, even in architectural views.

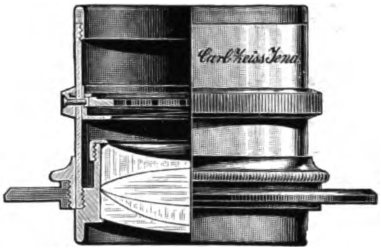
The Double-Protar, composed of two single lenses, is as free from distortion as any of the best existing symmetrical lenses; neither does it matter whether the combination consists of two lenses of similar or of dissimilar focus. The combination of two lenses of similar focus possesses, however, the advantage, over those composed of two dissimilar foci, of having a larger relative aperture, hence greater rapidity. On the other hand, two dissimilar lenses provide a range of three foci, whereas two similar ones restrict the choice to two.

An assortment of more than two Protar-lenses of different focus forms a Protar-Set, the elements of which can be used singly or in pairs.

We supply any of these single Protar-lenses separately, having listed them under Series VII, with a view to facilitating the gradual acquisition of Double-Protars or of assorted sets of these lenses. (See "Protar-Sets").

PROTAR-LENS

in Standard Mount with Iris-Diaphragm.

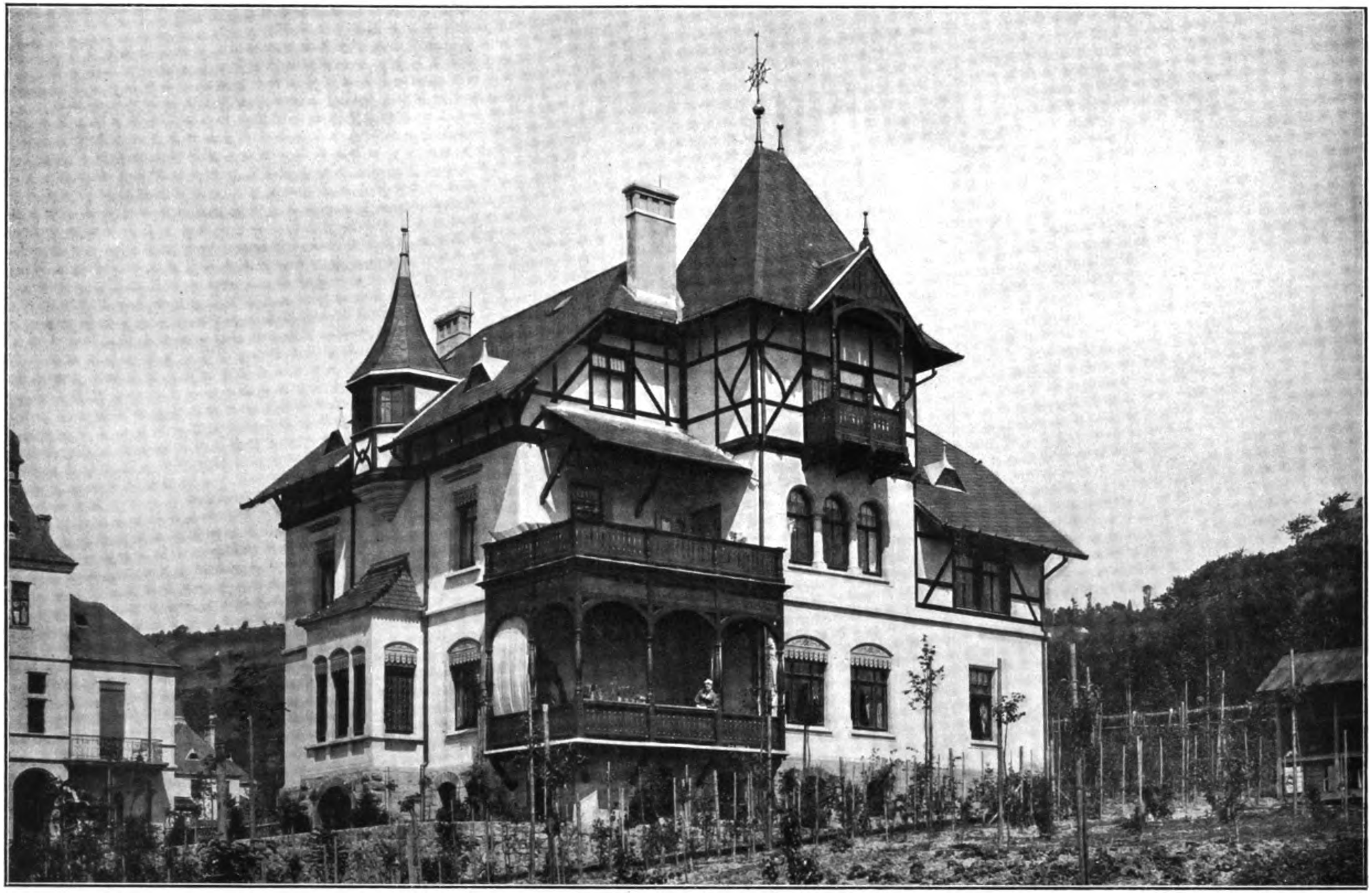


Series and No.	Protar-Lens in Standard Mount Code-word	Price	Diameter of Lenses		Equivalent Focus		Extension		Largest relative aperture	Size of Plate covered at Full aperture		Size of Plate covered at 1 : 25		Diameter of image within Field of 75°		Standard Mount
		$	mm	in.	mm	in.	mm	in.	1 :	cm	in.	cm	in.	cm	in.	No.
VII, 0	**Abdera**	**31.50**	11	$^{7}/_{16}$	100	4	115	$4^{1}/_{2}$	11	6 × 9	$2^{3}/_{8}$ × $3^{1}/_{2}$	9 × 11	$3^{1}/_{2}$ × $4^{5}/_{16}$	15	6	0
VII, 00	**Absynth**	**31.50**	14	$^{9}/_{16}$	135	$5^{5}/_{16}$	158	6	11	7 × 10	$2^{3}/_{4}$ × 4	12 × 15	$4^{3}/_{4}$ × 6	21	$8^{1}/_{4}$	I
VII, 000	**Abydos**	**31.50**	18	$^{11}/_{16}$	170	$6^{5}/_{8}$	198	$7^{3}/_{4}$	11	9 × 12	$3^{1}/_{2}$ × $4^{3}/_{4}$	13 × 18	$5^{1}/_{8}$ × 7	26	$10^{1}/_{4}$	II
VII, 1	**Acacia**	**26.—**	16	$^{5}/_{8}$	183	$7^{3}/_{16}$	204	8	12.5	12 × 15	$4^{3}/_{4}$ × 6	16 × 21	$6^{1}/_{2}$ × $8^{1}/_{4}$	28	11	I
VII, 2	**Acarina**	**29.50**	20	$^{3}/_{4}$	224	$8^{3}/_{4}$	249	$9^{3}/_{4}$	12.5	13 × 18	$5^{1}/_{8}$ × 7	21 × 27	$6^{1}/_{2}$ × $10^{5}/_{8}$	34	$13^{1}/_{4}$	II
VII, 3	**Aceton**	**35.—**	25	1	285	$11^{3}/_{16}$	317	$12^{7}/_{16}$	12.5	16 × 21	$6^{1}/_{2}$ × $8^{1}/_{4}$	24 × 30	$9^{1}/_{2}$ × $11^{3}/_{4}$	44	$17^{1}/_{4}$	III
VII, 4	**Achilles**	**42.—**	31	$1^{3}/_{16}$	350	$13^{3}/_{4}$	386	$15^{1}/_{4}$	12.5	21 × 27	$8^{1}/_{4}$ × $10^{5}/_{8}$	29 × 34	$11^{3}/_{8}$ × $13^{1}/_{4}$	54	$21^{1}/_{4}$	IV$_{1}$
VII, 5	**Acidalia**	**54.—**	36	$1^{3}/_{8}$	412	16	452	$17^{3}/_{4}$	12.5	24 × 30	$9^{1}/_{2}$ × $11^{3}/_{4}$	30 × 40	$11^{3}/_{4}$ × $15^{3}/_{4}$	63	$24^{3}/_{4}$	VI
VII, 6	**Aconitum**	**75.—**	42	$1^{5}/_{8}$	480	$18^{7}/_{8}$	526	$20^{5}/_{8}$	12.5	29 × 34	$11^{3}/_{8}$ × $13^{1}/_{4}$	34 × 39	$13^{1}/_{4}$ × $15^{3}/_{8}$	74	29	VIII
VII, 7	**Adinol**	**96.—**	51	2	590	$23^{1}/_{8}$	653	$25^{3}/_{4}$	12.5	30 × 40	$11^{3}/_{4}$ × $15^{3}/_{4}$	40 × 50	$15^{3}/_{4}$ × $19^{5}/_{8}$	91	$35^{3}/_{4}$	X$_{1}$
VII, 8	**Aeneas**	**125.50**	61	$2^{3}/_{8}$	690	27	764	30	12.5	34 × 39	$13^{1}/_{4}$ × $15^{3}/_{8}$	50 × 60	$19^{5}/_{8}$ × $23^{1}/_{2}$	106	$38^{5}/_{8}$	XII$_{1}$
VII, 9	**Affect**	**174.50**	71	$2^{3}/_{4}$	782	$30^{3}/_{4}$	866	34	12.5	39 × 47	$15^{3}/_{8}$ × $18^{1}/_{2}$	55 × 65	$21^{5}/_{8}$ × $25^{1}/_{2}$	120	$47^{1}/_{8}$	XIII
VII, 10	**Afra**	**226.50**	82	$3^{1}/_{4}$	862	$33^{7}/_{8}$	954	$37^{1}/_{2}$	12.5	40 × 50	$15^{3}/_{4}$ × $19^{5}/_{8}$	60 × 70	$23^{1}/_{2}$ × $27^{1}/_{2}$	132	$51^{7}/_{8}$	XIV
VII, 11	**Agave**	**296.50**	94	$3^{11}/_{16}$	1000	$39^{1}/_{4}$	1108	$43^{1}/_{2}$	12.5	47 × 57	$18^{1}/_{2}$ × $22^{3}/_{8}$	70 × 80	$27^{1}/_{2}$ × $31^{1}/_{2}$	153	60	XV

Protar-lenses may be obtained without tube-mount if required to complete an existing set. In this case prices are subject to a reduction of 5 and 10 Marks for Nos. 0 to 5 and 6 to 11 of Series VII respectively. The existing tube-mount must be sent to us for adaptation, otherwise we cannot answer for perfectly fitting screws.

For the preparation of stereoscopic views and similar purposes pairs of objectives of strictly **similar focus, and requiring the same camera extension and the same amount of stopping,** are supplied to order, at an extra cost of 3.— $ per pair.

In view of the French Patent Laws the objectives of Series VII and VII^{a} must not be introduced into France by way of trade.



Picture taken with Protar-lens, Series VII.

Series VIIa.

DOPPEL-PROTAR.

A symmetrical objective consisting of two single Protar-Lenses, Series VII.

Any two of the Protar-lenses comprised in Series VII may be combined in one tube-mount so as to form the Double-Protar. Among the many possible combinations of this kind we regard the doublets specified in the table on the following page as particularly useful. According to the similarity or dissimilarity of the foci of the two lenses so combined, the doublet has a relative aperture of 1:6.3, 1:7, or 1:7.7. The angle embraced by the combinations 0, 00, 000 and 25, 28 and 30 is about 70°; in all other combinations it is 80°. The plates are sharply covered up to the edge, even at full aperture. The field possesses anastigmatic flatness of great perfection.

By virtue of their large relative aperture and their anastigmatically flat field of great angular extent **the Double-Protars come under the heading of Rapid Anastigmatic Universal Lenses.** They are, for this reason, adapted for all branches of **Instantaneous Photography** — from single figures to wide-angle street scenes — for **Groups, Architecture, Panoramic Landscape Views, Reproductions,** also for **Photogrammetry and Enlarging.** Besides, the two separable elements of the Double-Protar are, as already pointed out, rapid single lenses of great excellence, possessing considerably longer foci than the corresponding doublets. Hence the component single lenses afford an excellent means of producing large figures, groups and landscape views from a great distance, in fact, any kind of photograph requiring lenses of relatively long focus.

The Double-Protars are accordingly **universally applicable** to an extent never yet realized in any other form of lens*).

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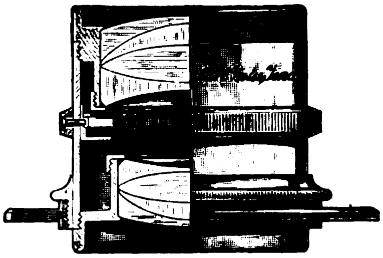
*) Dr. P. RUDOLPH, Jena: "Der neue Satz-Anastigmat 1:6.3 der Firma CARL ZEISS", EDER's Jahrbuch, 1896, p. p. 216 et seq.

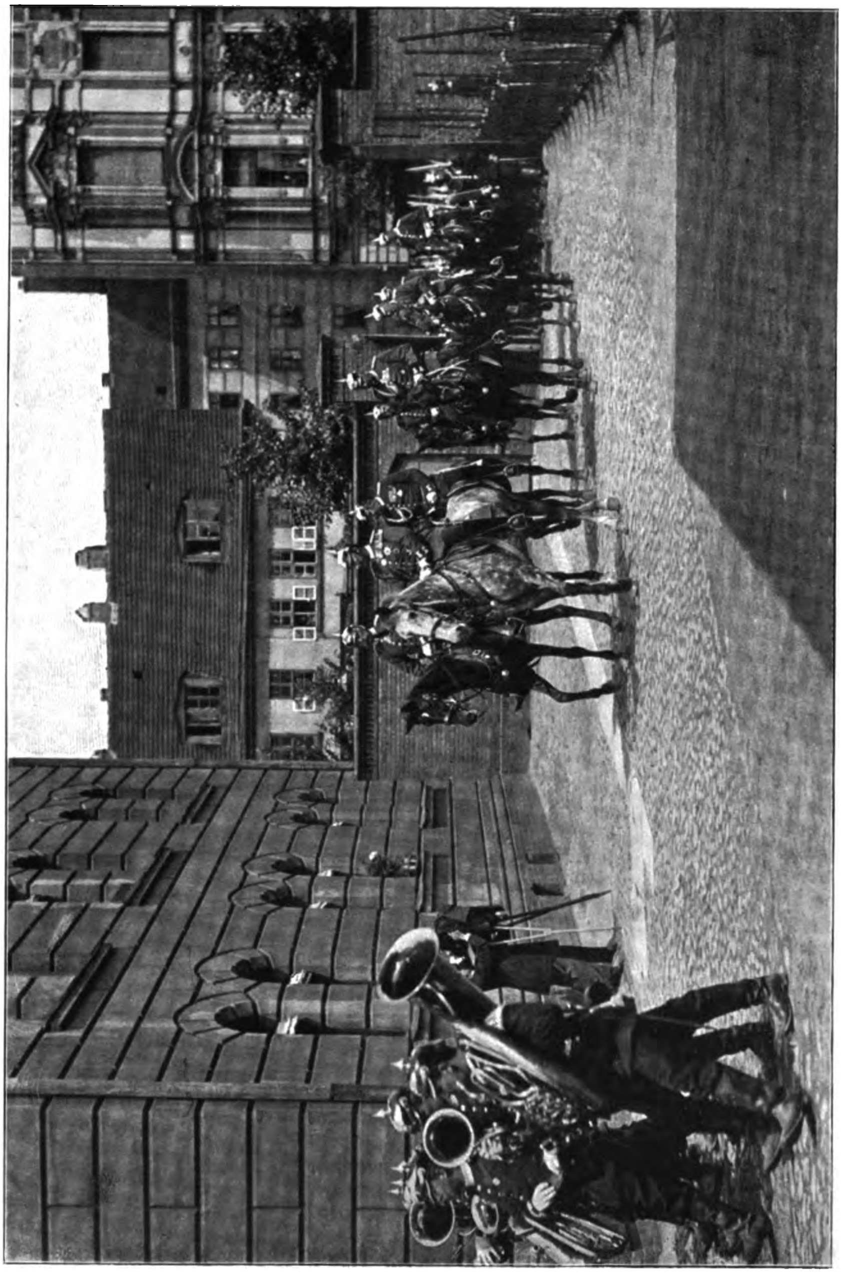
THE DOUBLE-PROTAR

in Standard Mount with Iris-Diaphragm.

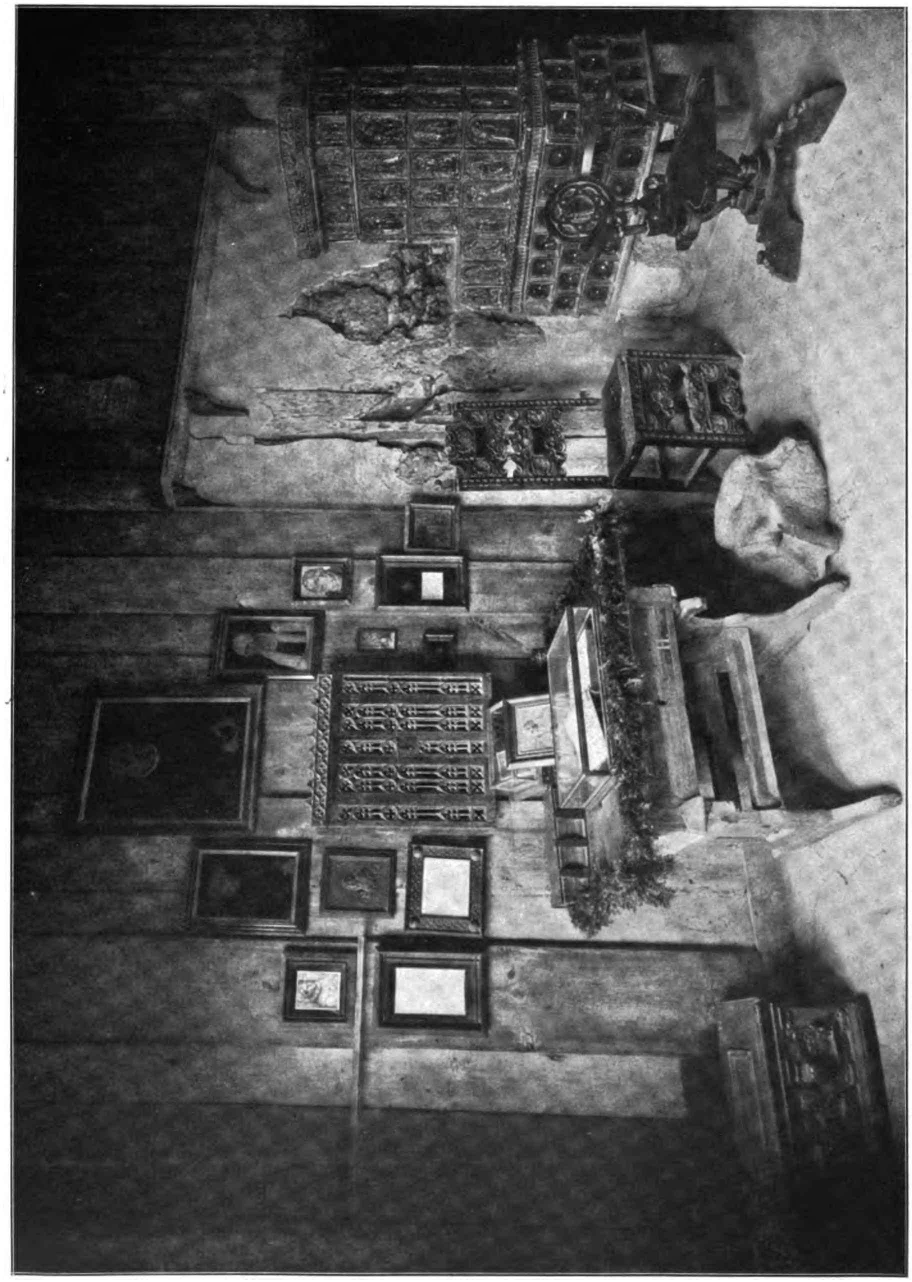


Series and No.	The Double-Protar in Standard Mount		Combination of Protar-Lenses Series VII				Combined Focus	Extension for smallest mount	Largest relative aperture	Size of Plate covered at		Diameter of image with small stops	Standard Mount
	Code-word	Price	Front Lens Focus		Back Lens Focus					full aperture (Instantaneous)	1:25 (Wide-angle)		
		$	mm	in.	mm	in.	in.	in.	1 :	in.	in.	in.	No.
VII^{a}, 0	**Accord**	**61.—**	100	4	100	4	2 3/8	2 3/16	5.6	1 9/16 × 1 9/16	2 × 2 3/8	3 3/8	0 II
VII^{a}, 00	**Agathe**	**61.—**	135	5 5/16	135	5 5/16	3 1/4	2 3/4	5.6	2 × 2	2 3/8 × 3 1/8	4 5/16	I II
VII^{a}, 000	**Agnes**	**61.—**	170	6 5/8	170	6 5/8	4	3 3/4	5.6	2 3/8 × 2 3/8	3 1/8 × 4	5 1/2	II
VII^{a}, 1	**Agonie**	**50.50**	183	7 3/16	183	7 3/16	4 1/8	3 7/8	6.3	2 3/4 × 4	4 × 5 1/8	8 11/16	I II III
VII^{a}, 2	**Alabaster**	**54.—**	224	8 3/4	183	7 3/16	4 1/2	4 5/16	7.0	3 1/2 × 4 3/4	4 3/4 × 6	7 1/2	II III
VII^{a}, 3	**Alauda**	**59.50**	285	11 3/16	183	7 3/16	5	4 5/8	7.7	4 × 5 1/8	5 1/8 × 6 1/2	8 1/4	III
VII^{a}, 4	**Albatros**	**57.50**	224	8 3/4	224	8 3/4	5 1/16	4 13/16	6.3	4 × 5 1/8	5 1/8 × 7	8 5/8	II III IV$_1$
VII^{a}, 5	**Alizarin**	**63.—**	285	11 3/16	224	8 3/4	5 5/8	5 1/4	7.0	4 3/4 × 6	5 1/8 × 8 1/4	9 1/2	III IV$_1$
VII^{a}, 6	**Alkaloid**	**70.—**	350	13 3/4	224	8 3/4	6	5 1/2	7.7	5 1/8 × 6	6 1/2 × 8 1/4	10 1/4	IV$_1$
VII^{a}, 7	**Alkohol**	**68.—**	285	11 3/16	285	11 3/16	6 3/8	6	6.3	5 1/8 × 6 1/2	6 1/2 × 8 1/4	10 5/8	III IV$_1$ VI VIII
VII^{a}, 8	**Amidon**	**75.—**	350	13 3/4	285	11 3/16	7	6 1/2	7.0	5 1/8 × 7	7 × 9 1/2	11 3/4	IV$_1$ VI VIII
VII^{a}, 9	**Ananas**	**87.—**	412	16	285	11 3/16	7 1/2	7	7.7	5 1/8 × 8 1/4	7 × 9 1/2	12 1/2	VI VIII
VII^{a}, 10	**Anchovis**	**82.—**	350	13 3/4	350	13 3/4	7 7/8	7 1/4	6.3	5 1/8 × 8 1/4	8 1/4 × 10 1/4	13 3/8	IV$_1$ VI VIII
VII^{a}, 11	**Anilin**	**94.—**	412	16	350	13 3/4	8 1/2	7 13/16	7.0	6 1/2 × 8 1/4	9 × 11	14 1/8	VI VIII
VII^{a}, 12	**Anthracit**	**115.—**	480	18 7/8	350	13 3/4	9 1/8	8 1/4	7.7	6 1/2 × 8 1/4	9 1/2 × 11 3/4	15 3/8	VIII
VII^{a}, 13	**Antimon**	**106.50**	412	16	412	16	9 1/4	8 1/2	6.3	6 1/2 × 8 1/4	9 1/2 × 11 3/4	15 1/4	VI VIII
VII^{a}, 14	**Antipyrin**	**127.50**	480	18 7/8	412	16	10	9	7.0	7 × 9 1/2	9 1/2 × 11 3/4	16 7/8	VIII
VII^{a}, 15	**Apostat**	**148.—**	590	23 1/8	412	16	10 7/8	9 3/4	7.7	7 × 9 1/2	10 1/4 × 12 1/8	18 1/2	X$_1$
VII^{a}, 16	**Aristos**	**146.50**	480	18 7/8	480	18 7/8	10 13/16	9 15/16	6.3	7 × 9 1/2	10 1/4 × 12 1/8	18 1/8	VIII
VII^{a}, 17	**Asbest**	**167.50**	590	23 1/8	480	18 7/8	11 7/8	10 13/16	7.0	8 1/4 × 10 1/4	11 × 13	20	X$_1$
VII^{a}, 18	**Athene**	**197.—**	690	27	480	18 7/8	12 3/4	11 1/2	7.7	8 1/4 × 10 1/4	11 × 13 3/8	21 1/4	XII$_1$
VII^{a}, 19	**Atlas**	**188.—**	590	23 1/8	590	23 1/8	13 1/4	12 1/8	6.3	8 1/4 × 10 1/4	11 3/8 × 13 3/8	22 3/8	X$_1$
VII^{a}, 20	**Atropin**	**218.—**	690	27	590	23 1/8	14 5/16	12 15/16	7.0	9 1/2 × 11 3/4	11 3/4 × 15 3/4	24	XII$_1$
VII^{a}, 22	**Aurora**	**247.50**	690	27	690	27	15 1/2	14 1/8	6.3	9 1/2 × 11 3/4	11 3/8 × 15 1/4	26	XII$_1$
VII^{a}, 25	**Aurum**	**345.—**	782	30 3/4	782	30 3/4	18 1/4	16 11/16	6.3	9 1/2 × 11 3/4	15 3/4 × 19 5/8	26	XIII
VII^{a}, 28	**Ave**	**450.—**	862	33 7/8	862	33 7/8	20 1/4	18 5/8	6.3	11 × 13 3/8	17 5/8 × 21 5/8	28 1/4	XIV
VII^{a}, 30	**Azalie**	**589.—**	1000	39 1/4	1000	39 1/4	23 3/8	21 1/2	6.3	11 3/4 × 15 3/4	15 3/4 × 23 1/2	31 1/2	XV

For the preparation of stereoscopic views and similar purposes pairs of objectives of strictly **similar focus**, and requiring **the same camera extension** and **the same amount of stopping**, are supplied to order, at an extra cost of 3.— $ per pair. It should, however, be noted that a pair of objectives of Series VII^{a} is subject to an additional charge of 6.— $ (instead of 3.— $), if it be required to use the single lenses for stereoscopic work as well as their combinations.



Franz Kühn, Berlin phot.



Interior of Wartburg.

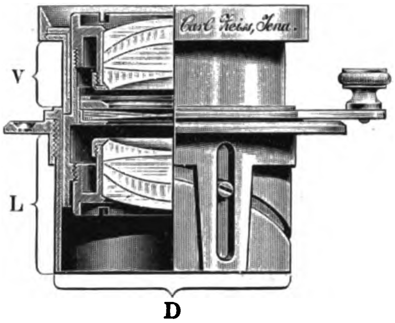
Carl Zeiss, Optische Werkstaette, Jena.

For adaptation to **Hand Cameras** with **focal plane shutter** and fixed extension we recommend

THE DOUBLE-PROTAR

in Special Mount A with

Iris-Diaphragm and Focusing Attachment



Series and No.	Double-Protar in Special Mount A		Diameter of Lenses		Equivalent Focus		Extension		Size of Plate covered				Special Mount
									from		to		
	Code-word	Price $	mm	in.	mm	in.	mm	in.	cm	in.	cm	in.	No.
VII a, 0	**Accordial**	**64.50**	11	7/16	61	2 3/8	66	2 5/8	4 × 4	1 9/16 × 1 9/16	5 × 6	2 × 2 3/8	*A* II
VII a, 00	**Agathial**	**64.50**	14	9/16	82	3 1/4	87	3 7/16	5 × 6	2 × 2 3/8	6 × 8	2 3/8 × 3 1/8	*A* II
VII a, 000	**Agnial**	**64.50**	18	11/16	102	4	107	4 3/16	6 × 8	2 3/8 × 3 1/8	8 × 10	3 1/8 × 4	*A* II
VII a, 1	**Agonial**	54.—	16	5/8	105	4 1/8	110	4 5/16	6 × 8	2 3/8 × 3 1/8	8 × 10	3 1/8 × 4	*A* II
VII a, 4	**Albatrial**	61.—	20	3/4	128	5 1/16	132	5 3/16	8 × 10	3 1/8 × 4	9 × 12	3 1/2 × 4 3/4	*A* II
VII a, 5	**Alizarial**	**66.50**	25	1	143	5 5/8	151	6 1/16	8 × 10	3 1/8 × 4	9 × 12	3 1/2 × 4 3/4	*A* III
VII a, 7	**Alkoial**	**71.50**	25	1	163	6 3/8	171.5	6 3/4	9 × 12	3 1/2 × 4 3/4	12 × 15	4 3/4 × 6	*A* III
VII a, 8	**Amidonal**	80.50	31	1 3/16	179	7	188	7 3/8	12 × 15	4 3/4 × 6	13 × 18	5 1/8 × 7	*A* IV$_1$
VII a, 10	**Anchovial**	87.—	31	1 3/16	200	7 7/8	214	8 3/8	12 × 15	4 3/4 × 6	13 × 18	5 1/8 × 7	*A* IV$_1$

Protar-Sets

formed by combination of single Protar-Lenses, Series VII.

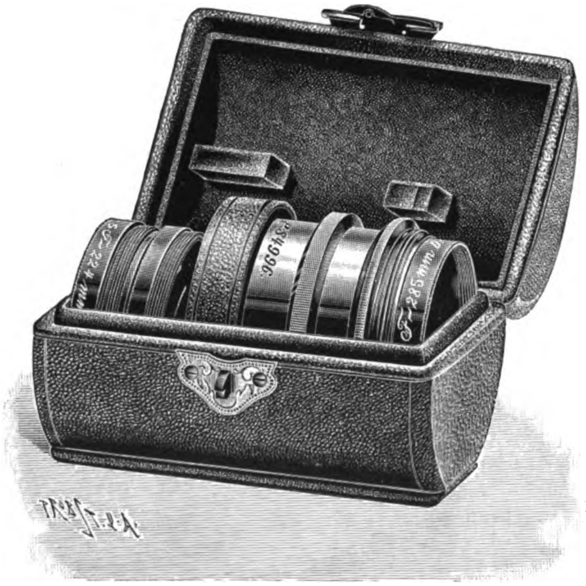
With the aid of the Table on page 70 a selection of suitable lenses of Series VII may easily be made so as to form Protar-Sets adapted for special purposes, which sets, **though consisting of but a small number of elements, provide a considerable range of rapid objectives of various foci.** They all belong to Series VII and VII^a and are therefore of the highest optical quality. Each element of such set is, in fact, a Rapid Anastigmatic Single Lens (Series VII), and any pair of these forms a Universal Objective (Series VII^a) of the highest quality.

We stock regularly the sets specified under the headings C and D, which are adapted for plates measuring 13 × 18 and 18 × 24 cm ($5^1/_8$ × 7 and 7 × $9^1/_2$ in.), but any other sets may also be supplied to order.

Each of the stock sets (C and D) consists of:

1) A tube (Standard Mount Nos. IV$_1$ and VIII resp.) fitted with iris-diaphragm and provided with screw-threads fitting the objectives.
2) Three or four Protar-lenses, Series VII, having their focal length engraved upon the cell.
3) A screen-ring or hood, screwing into the front of the tube so as to shut off reflected light.
4) A case to contain the lenses and fittings of the set.
5) A lens flange to fasten to the camera front with screws.

When these lenses are to be used singly, they are screwed into the back of the tube (the end bearing the outside thread) and the screen-ring or hood into the front. When two lenses are to be combined so as to form a Double-Protar, the hood is replaced by the second lens, and whenever lenses of dissimilar foci are used, the longer focus lens should occupy the position of the hood in front, as in this way the greatest possible aperture is obtained in the combination.



Protar-Set C.
($^2/_3$ actual size.)

Set C

for Plates 13 × 18 cm ($5^1/_8$ × 7 in.),

consisting of Protar-Lenses, Series VII, Nos. 2, 3 and 4.

Price, incl. Case: $ 103.—. Code-Word: **Alpha.**

Size of Case: 6 × 6 × 8 cm ($2^3/_8$ × $2^3/_8$ × $3^1/_8$ in.).

Weight of the Set: in Brass, 320 gr ($11^1/_4$ ozs.); in Aluminium, 277 gr ($9^3/_4$ ozs.).

Series and No.	Focus of				Largest relative Aperture	Angle corresp. to Plate 13 × 18 cm ($5^1/_8$ × 7 in.)	Size of Plate covered at			Diameter of image corresp. to an Angle of 80°
	Front Lens in.	Back Lens in.	Combination mm	Combination in.	1 :		Full aperture in.	1 : 12.5 in.	1 : 25 in.	in.
VII, 4	—	$13^3/_4$	350	$13^3/_4$	12.5	35°	—	$8^1/_4$ × $10^5/_8$	$11^3/_8$ × $13^1/_4$	—
VII, 3	—	$11^3/_{16}$	285	$11^3/_{16}$	12.5	43°	—	$6^1/_2$ × $8^1/_4$	$9^1/_2$ × $11^3/_4$	—
VII, 2	—	$8^3/_4$	224	$8^3/_4$	12.5	53°	—	$5^1/_8$ × 7	$8^1/_4$ × $10^5/_8$	—
VII^a, 8	$13^3/_4$	$11^3/_{16}$	179	7	7	64°	$5^1/_8$ × 7	$6^1/_2$ × $8^1/_4$	7 × $9^1/_2$	$11^3/_4$
VII^a, 6	$13^3/_4$	$8^3/_4$	156	$6^1/_8$	7.7	71°	$4^3/_4$ × $6^1/_2$	6 × $7^7/_4$	$6^1/_2$ × $8^1/_4$	$10^1/_4$
VII^a, 5	$11^3/_{16}$	$8^3/_4$	143	$5^5/_8$	7	76°	$4^3/_4$ × 6	$5^1/_8$ × $8^1/_8$	$5^1/_8$ × $8^1/_3$	$9^1/_2$

If it is required to supplement this set by a typically wide-angle lens, Protar 1 : 18, $f = 112$ mm ($4^3/_8$ in.), Series V, No. 2, commends itself. Price $ **22.50**. This lens covers a plate 13 × 18 cm ($5^1/_8$ × 7 in.) and embraces an angle of 90°.

Set D

for Plates 18 × 24 cm (7 × $9^1/_2$ in.),

consisting of Protar-Lenses, Series VII, Nos. 3, 4, 5 and 6.

Price, incl. Case: $ **200.50**. Code-Word: **Alphabet.**

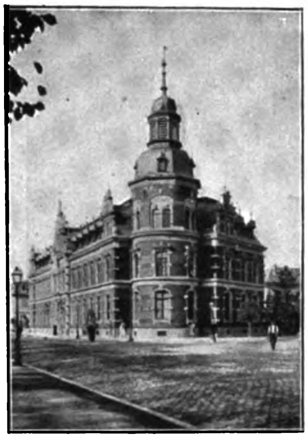
Size of Case: 8 × 8 × 14 cm ($3^1/_8$ × $3^1/_8$ × $5^1/_2$ in.).

Weight of the Set: in Brass, 760 gr (27 ozs.); in Aluminium 665 gr ($23^1/_2$ ozs.).

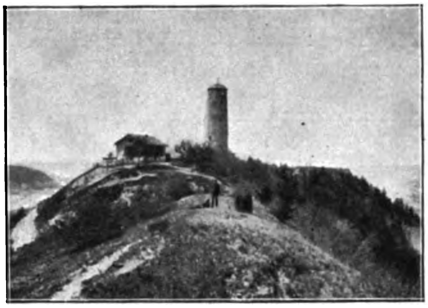
Series and No.	Focus of				Largest relative Aperture	Angle corresp. to Plate 18 × 24 cm (7 × $9^1/_2$ in.)	Size of Plate covered at			Diameter of image corresp. to an Angle of 80°
	Front Lens in.	Back Lens in.	Combination mm	Combination in.	1 :		Full aperture in.	1 : 12.5 in.	1 : 25 in.	in.
VII, 6	—	$18^7/_8$	480	$18^7/_8$	12.5	34°	—	$11^3/_8$ × $13^1/_4$	$13^1/_4$ × $15^3/_8$	—
VII, 5	—	16	412	16	12.5	40°	—	$9^1/_2$ × $11^3/_4$	$11^3/_4$ × $15^3/_4$	—
VII, 4	—	$13^3/_4$	350	$13^3/_4$	12.5	46°	—	$8^1/_4$ × $10^5/_8$	$11^3/_8$ × $13^1/_4$	—
VII, 3	—	$11^3/_{16}$	285	$11^3/_{16}$	12.5	55°	—	$6^1/_2$ × $8^1/_4$	$9^1/_2$ × $11^3/_4$	—
VII^a, 14	$18^7/_8$	16	254	10	7	61°	7 × $9^1/_2$	$9^1/_2$ × $11^3/_4$	$9^1/_2$ × $11^3/_4$	$16^7/_8$
VII^a, 12	$18^7/_8$	$13^3/_4$	232	9	7.7	66°	$6^1/_2$ × $8^1/_4$	9 × 11	$9^1/_2$ × $11^3/_4$	$15^3/_8$
VII^a, 11	16	$13^3/_4$	216	$8^1/_2$	7	69°	$6^1/_2$ × $8^1/_4$	$8^1/_4$ × $10^1/_4$	9 × 11	$14^1/_8$
VII^a, 9	16	$11^3/_{16}$	192	$7^1/_2$	7.7	76°	$5^1/_8$ × $8^1/_{14}$	7 × $9^1/_2$	7 × $9^1/_2$	$12^1/_2$
VII^a, 8	$13^3/_4$	$11^3/_{16}$	179	7	7	80°	$5^1/_8$ × 7	$6^1/_2$ × $8^1/_4$	7 × $9^1/_2$	$11^3/_4$

If it is desired to supplement this set by a typically wide-angle lens, No. 3 of Series V, Protar 1 : 18, $f = 141$ mm ($5^1/_2$ in.), commends itself. Price $ **28.—**. This lens covers a plate 18 × 24 cm (7 × $9^1/_2$ in.) and embraces an angle of $93^1/_2$°.

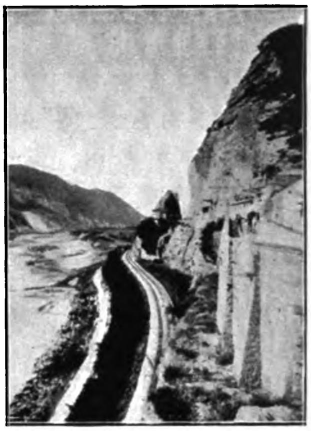
Cases for other combinations than those specified under „C“ and „D“, not being kept in stock, are charged for at special rates.



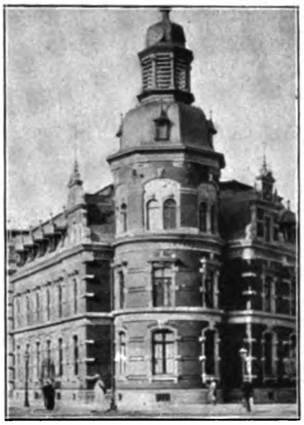
I$_{,1}$.



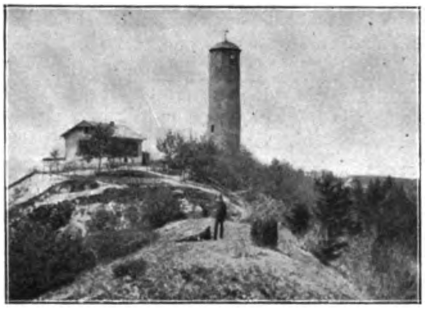
II$_{,1}$.



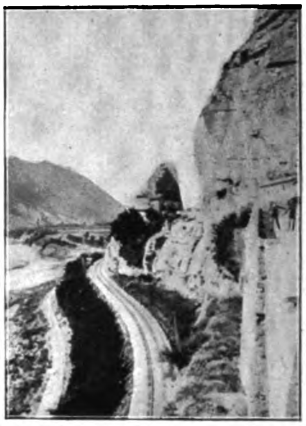
III$_{,1}$.



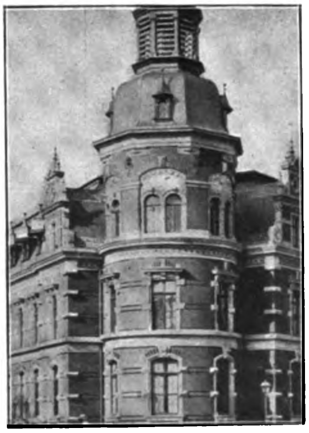
I$_{,2}$.



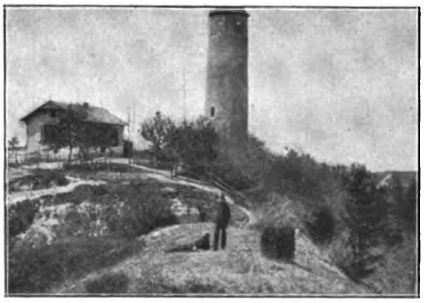
II$_{,2}$.



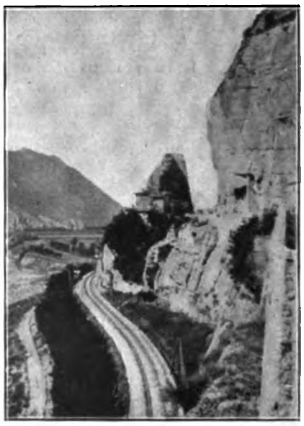
III$_{,2}$.



I$_{,3}$.



II$_{,3}$.



III$_{,3}$.

Examples of effective application of the
Double-Protar and its component **Protar-Lenses, Series VII.**

See remarks on next page.

Application of the Double-Protar to the purposes of a Convertible Set of Objectives

composed of two dissimilar-focus lenses of Series VII.

Each series (1, 2, 3) of the pictures I, II and III, shown on the preceding page, was taken from the same position.

Series 1 was taken with the shortest focus, i. e., with the Double-Protar. The front lens was then screwed off and series 2 taken with the back lens alone, i. e., with a single Protar-lens of Series VII. Series III was taken with the back lens unscrewed and the front lens of the Protar occupying **its place** in the tube mount.

The objective used was a Double-Protar composed of two successive numbers in the list of Protar-lenses of Series VII, constituting a Double-Protar with relative aperture 1 : 7, the foci of which gave the proportion

Double-Protar : Back Lens : Front Lens = 1 : 6 : 2.

Picture I demonstrates that, from the position chosen and for the plate size selected, the shortest focus (the Double-Protar) yielded the most effective and a really satisfactory photograph. Picture II proves that the intermediate focus — that of the back lens —, and picture III that the longest focus, obtained by substituting the front lens for the back lens, were preferable for the work in hand.

Tables of Stops and Foci for Protar-Sets.

As a convenient means of finding the required amount of stopping and the equivalent foci of the objective combinations, we have constructed tables which may be affixed to the lens cap. Copies of these tables are always available for such of the Protar-lenses of Series VII as are regularly stocked in the following standard mounts, viz: Nos. II, III, IV$_1$, VI, VIII, X$_1$ and XII$_1$ (see pag. 13).

Each table gives the diameters of the stops for three or four lenses of Series VII, as also for their combinations. For instance, the table supplied with the cap of Standard Mount IV$_1$ contains the necessary data for Protar-lenses, Series VII, $f = 350$, 285 and 224 mm ($13^3/_4$, $11^1/_4$ and $8^3/_8$ in.), and also for their combinations found under the heading of Double-Protar, Series VII^a. These tables are arranged in the form of rosettes, as shown in the appended illustration. The central division is in the shape of an octagon, the sides of which form the bases of 8 sectors dividing the circumference of the circle. One of the sections shows the headings referring to the numerical data given in the other seven. Thus, the outermost circle of figures indicates the foci of the above-mentioned three lenses of Series VII. The next three circular rows show the diameters of the stops for the combination of any two of these single lenses; the fifth row gives the relative apertures corresponding to the diameters of the stops shown in the several sections. The corresponding rapidities, or the numbers of stops, will be found in the sixth circle. The central space contains the continuation of the data supplied in the sections, by giving the foci resulting from the combination of any two single lenses into a double objective (a Double-Protar, Series VII^a). These combinations are specified in the same sequence as the diameters of the corresponding stops given in the sections.

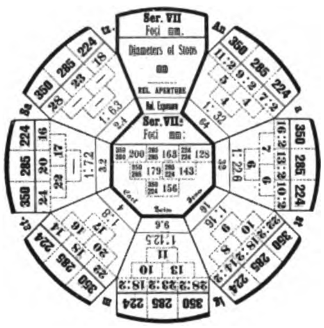


Table of Stops
for Protar-Set C, 13 cm × 18 cm
($5^1/_8$ × 7 in.).

Accordingly, if it be intended to work at the relative aperture 1 : 18, combination $\frac{350}{350}$ (Series VII^a No. 10) = 200 mm ($7^7/_8$ in.) requires a stop of 20 : 2 = 10 mm; combination $\frac{285}{285}$ (Series VII^a No. 7) = 163 mm ($6^3/_8$ in.) a stop of 16 : 2 = 8 mm; combination $\frac{224}{224}$ (Series VII^a, No. 4) = 128 mm (5 in.) a stop of 13 : 2 = 6.5 mm; combination $\frac{350}{285}$ (Series VII^a, No. 8) = 179 mm (7 in.) a stop of 9 mm, and so forth. The system of arrangement of the sections, furthermore, enables one to find the diameters of the stops at a glance, if it be only remembered that the first row of figures applies to the combination of two similar foci, the second row to the combination of two successive numbers, and the third row to that of one number with an alternate one.

It only remains to explain why the diameters of the stops for the relative apertures 1 : 36 to 1 : 12.5 incl., which appear in the outermost row, have been expressed by fractional numbers with the denominator 2. The object of this arrangement is, to express by the numerator the diameters of the stops applicable to each separate number of Series VII when used as a single objective. If, for instance, it be intended to work with a single lens at the relative aperture 1 : 36, the iris-diaphragm of Protar-lens, Series VII, $f = 350$ mm should be set to 10 mm, in the case of Protar-lens $f = 285$ mm to 8 mm, and so forth.

Leather Cases for Photographic Objectives in Standard Mounts.

The smaller sizes of objectives specified in the tables of the catalogue are sent out in plain pasteboard covers. When, however, durability is a desideratum, we recommend more substantial cases. These are strongly and neatly made in our own workshops and are covered with shagreen leather. The prices are as follows:

Series and Number to fit case							Standard Mount	Adapted for Standard Mount	Price
I^a	I^b	II^a	III^a	V	VII	VII^a	No.	fitted with	$
—	—	—	0	1, 2	—	—	I	Revolving Diaphragm	0.50
—	—	—	00, 1, 2	3, 4	—	—	II		0.50
1, 2, 6	—	—	—	—	0	0	0	Iris-Diaphragm	0.50
3	—	0	—	—	00, 1	00, 1	I		0.50
4, 7	—	1, 2	—	5, 6, 7	0—2	0 -2, 4	II		0.50
5, 8	3	3	3, 4	7^a, 8	1, 2, 3	1—5, 7	III		0.60
9	—	4	5	—	2, 3, 4	4—8, 10	IV$_1$		0.70
—	4, 5	—	—	—	—	—	IV$_2$		0.70
10	—	5	6	—	—	—	V		0.70
—	—	6	—	9	3, 4, 5	7—11, 13	VI		0.90
—	6	—	7	—	—	—	VII		0.90
11	—	—	—	—	3, 4, 5, 6	7—14, 16	VIII		1.10
—	—	7	8	—	—	—	IX$_1$		1.10
12	—	—	—	—	—	—	IX$_2$		1.20
—	—	—	—	10	7	15, 17, 19	X$_1$		1.40
—	7	—	—	—	—	—	X$_2$		1.40
—	—	8	9	—	—	—	XI		1.40
13	—	—	10	—	8	18, 20, 22	XII$_1$		1.50
—	8	—	—	—	—	—	XII$_2$		1.50
14	9	—	—	—	9	25	XIII		1.70
15	10	—	11	—	10	28	XIV		2.—
16, 17	—	—	12	—	11	30	XV		2.10
18	—	—	—	—	—	—	XVII		2.50

Cases for articles not included above are made to order only, at reasonable rates.

In ordering one of the above-mentioned stock patterns, please quote series and number of objective, form of diaphragm fitted (whether a rotating or an iris-diaphragm), and the number engraved on the objective flange (the number of the tube-mount).

Hand-Cameras

fitted with our photographic objectives.

We do not make Photographic Cameras ourselves and undertake to fit objectives to hand-cameras only in exceptional cases, when it appears from the trade catalogues of manufacturers in business relations with us that a complete outfit as desired is not procurable from them.

The following is a list, taken from our books, of manufacturers who **regularly fit our objectives to their hand-cameras.** We also append a brief notice of their special line of goods and shall be glad to reply to any correspondents requiring fuller information. **The complete outfits should, of course, be obtained direct from the respective makers, or through the medium of a reputable dealer in photographic supplies.**

Name of Firm:	Specialities*):
Bellieni, H. Bellieni Fils, Nancy (France), 17 Place Carnot.	Jumelle stéréoscopique 8 × 9, with 2 Protars $^1/_8$, $f = 110$ mm; Jumelle simple 8 × 9 à deux foyers, with II^a, $f = 110$ mm, and III^a, $f = 80$ mm; Jumelle stéréoscopique 8 × 9 à deux foyers, with 2 Protars II^a, $f = 110$ mm, and 2 Protars V, $f = 80$ mm; Jumelle simple 9 × 12 à deux foyers, with II^a, $f = 136$ mm, and III^a, $f = 103$ mm.
Boucher, Paul Boucher, Paris, 39 Quai des Grands-Augustins.	Photo-Jumelle 9 × 12, with Protar $^1/_8$, $f = 136$ mm.
Boulade Frères, L. & A. Boulade Frères, Lyon-Monplaisir, 4 Rue St. Gervais.	Jumelle photographique 9 × 12, with Protar $^1/_9$, $f = 150$ mm, or Protar $^1/_8$, $f = 136$ mm; Jumelle stéréoscopique 8 × 16, with 2 Protars $^1/_9$, $f = 95$ mm; 6 × 13 with 2 Protars $^1/_9$, $f = 75$ mm.
Ernemann, Heinrich Ernemann, Aktiengesellschaft für Camerafabrikation, Dresden, Schandauerstr. 48.	Hand-cameras of various patterns and sizes, fitted with Protar $^1/_9$, $f = 120$ mm, Protar $^1/_9$, $f = 150$ mm, and Protar $^1/_9$, $f = 196$ mm.

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*) For Brit. equivalents of the dimensions of plates and of objective foci see tables referring to the lenses in question.

Name of Firm:	Specialities:
Gaumont, L. Gaumont & Cie., Paris, 57 Rue Saint-Roch.	Spido 9 × 12, with Protar $^1/_8$, $f = 136$ mm; Stereospido 6 × 13, with Protar $^1/_8$, $f = 110$ mm; Stereospido 8 × 16, with Protar $^1/_8$, $f = 136$ mm; Jumelle Elge à deux éléments 8 × 8, with Protar $^1/_8$, $f = 110$ mm.
Gauthier, Alfred Gauthier, Paris, 31 Rue Pastourelle.	Jumelle Alaska 9 × 12, with Protar $^1/_8$, $f = 136$ mm; Jumelle Alaska stéréoscopique 8 × 16 and 8$^1/_2$ × 17, with 2 Protars $^1/_8$, $f = 110$ mm; Detective „Le Régent“ 9 × 12, with Protar $^1/_8$, $f = 136$ mm.
Goldmann, Rud. A. Goldmann, Vienna IV, Victorgasse 14.	Universal Detective-Camera 9 × 12, with Protar $^1/_8$, $f = 136$ mm, or Double-Protar, $f = 128$ mm, or Unar $^1/_{4\cdot5}$, $f = 136$ mm; Universal Detective-Camera 12 × 16.5, with Protar $^1/_8$, $f = 167$ mm, or Double-Protar, $f = 163$ mm; Universal Detective-Camera 13 × 18, with Protar $^1/_8$, $f = 205$ mm, or Double-Protar, $f = 200$ mm, or Unar $^1/_5$, $f = 210$ mm; Universal Stereoscopic Camera 9 × 18, with Protar $^1/_8$, $f = 136$ mm, or Double-Protar, $f = 128$ mm, or Unar $^1/_{4\cdot5}$, $f = 136$ mm; Folding Pocket-Camera 9 × 12, with Protar $^1/_8$, $f = 136$ mm, or Unar $^1/_{4\cdot5}$, $f = 136$ mm; Folding Pocket-Camera 12 × 16.5, with Protar $^1/_8$, $f = 136$ mm; Folding Pocket-Camera 13 × 18, with Protar $^1/_8$, $f = 205$ mm, or Unar $^1/_5$, $f = 210$ mm; Folding Stereoscopic Pocket-Camera 9 × 18, with 2 Protars $^1/_8$, $f = 136$ mm, or 2 Unars $^1/_{4\cdot5}$, $f = 136$ mm.
Harbers, Christian Harbers, Leipzig, Markt 6.	Rapid Detective-Camera 9 × 12 (Model Aarland-Harbers), with Unar $^1/_{4\cdot5}$, $f = 136$ mm.
Hüttig, Fabrik photographischer Apparate auf Aktien vorm. R. Hüttig u. Sohn, Dresden, Schandauerstr. 76.	Hand-Cameras of various construction and sizes, with Protar $^1/_9$, $f = 120$ mm, and Protar $^1/_9$, $f = 150$ mm, the following being the most important models: Monopol No. 12, Stereoscop-Monopol No. 15, Spiegel-Monopol No. 18, covering plates 12 × 16 or 13 × 18 cm. Kronke-Camera No. 27, Lloyd-Film-Camera No. 56, Stereoskop-Lloyd-Camera No. 5656, Lloyd-Camera No. 72.

Name of Firm:	Specialities:
Lechner, R. Lechner (Wilh. Müller), Vienna I, Graben 31.	Lili-Camera 9 × 9, with Protar $^1/_{6.3}$, $f = 105$ mm, for roller films, daylight changing; Pocket-Camera 9 × 12, with Protar $^1/_{6.3}$, $f = 105$ mm; Pocket-Camera 12 × 16, with Protar $^1/_8$, $f = 167$ mm; Stereoscopic Pocket-Camera 9 × 18, with Protar $^1/_{6.3}$, $f = 105$ mm; New Reflecting Mirror Camera 9 × 12, with Protar $^1/_{6.3}$, $f = 170$ mm. All of the above are fitted with focal plane shutters.
Mackenstein, H. Mackenstein, Paris, 15 Rue des Carmes.	Jumelle photographique 6.5 × 9 and 8 × 9, with Protar $^1/_8$, $f = 110$ mm; Jumelle photographique 9 × 12, with Protar $^1/_8$, $f = 136$ mm; the camera fronts of both the above are fitted with double slides. Jumelle stéréoscopique Minima 4.5 × 10.7, with Protar $^1/_{6.3}$, $f = 54$ mm; The same 6 × 13, with Protar $^1/_8$, $f = 90$ mm; Jumelle stéréoscopique ou panoramique 8 × 18, with Protar $^1/_8$, $f = 110$ mm, or Protar $^1/_{6.3}$, $f = 105$ mm; Handy-Camera 9 × 12 and Folding-Camera 9 × 12, with Protar $^1/_8$, $f = 136$ mm; The same for 13 × 18 plates, with Protar $^1/_8$, $f = 205$ mm.
Mazo, E. Mazo, Paris, 8 Boulevard Magenta.	Hand camera „Bayard“ and „Foldette“, 9 × 12, with Protar $^1/_8$, $f = 136$ mm.
Meyrowitz, E. B. Meyrowitz, 104 East 23rd Str. New York.	Hand-Cameras for small plates up to 9 × 12, equipped with Protar $^1/_8$, $f = 110$ mm, or Protar $^1/_8$, $f = 136$ mm.
Newman & Garcia, Ltd., London 90 u. 92 Shaftesbury Avenue.	Nydia Pocket-Camera 8.2 × 10.7, with Double-Protar $^1/_{6.3}$ $f = 138$ mm; Special B 9 × 12, for 2 foci, with Double-Protar $^1/_{6.3}$, $f = 128$ mm; Special B 9 × 12, for 3 different foci, with Double-Protar $^1/_7$, $f = 143$ mm; Twin - Lens 9 × 12 and Stereoscopic Camera 6.5 × 4.5, for 2 foci, with Double-Protar $^1/_{6.3}$, $f = 128$ mm; High-Speed 9 × 12, with Planar $^1/_{3.8}$, $f = 160$ mm, or Unar $^1/_5$, $f = 155$ mm.

Name of Firm:	Specialities:
Palmos, Aktiengesellschaft Camerawerk Palmos in Jena.	Hand-Cameras with focal plane shutters, for films and plates: Film-Palmos 6 × 9 (for films only), with Unar $^1/_{4\cdot5}$, $f = 112$ mm; Universal-Palmos 9 × 12 with Double-Protar $^1/_{6\cdot3}$, $f = 128$ mm, also for plates 13 × 18 with Double-Protar, $f = 179$ mm. This model is constructed to use the Double-Protar and also the component single lenses, which may be of similar or dissimilar foci; Folding-Camera 9 × 12, with Unar $^1/_{4\cdot5}$, $f = 136$ mm, or Protar $^1/_8$, $f = 136$ mm; The same for plates 13 × 18, with Unar $^1/_5$, $f = 210$ mm, or Protar $^1/_8$, $f = 205$ mm; Folding Stereoscopic Camera 9 × 18, with Unar $^1/_{4\cdot5}$, $f = 136$ mm, or Protar $^1/_8$, $f = 136$ mm, or Protar $^1/_9$, $f = 120$ mm.
Photo-Hall, Paris, 5 Rue Scribe.	Detective-Camera 6.5 × 9, with Protar $^1/_8$, $f = 110$ mm; Detective-Camera 9 × 12, with Protar $^1/_8$, $f = 136$ mm.
Richard, Jules Richard, Paris, 25 Rue Mélingue.	Vérascope appareil stéréoscopique 4.5 × 4.5, with Protar 1:6.3, $f = 54$ mm; Various models of Hand-Cameras with Protar 1:8, $f = 124$ mm, or Protar 1:6, $f = 105$ mm.
Stegemann, A. Stegemann, Berlin S., Oranienstrasse 151.	Hand-Cameras with focal plane shutters, for films and plates 6 × 9, 9 × 12, 9 × 18, 12 × 16.5 and 13 × 18.

Tele-photographic Objectives.

Construction and general properties of the Tele-photographic Objective.

The optical combination of the tele-photographic objective consists of:

1. the **positive-element** (a single or double photographic objective) and
2. the **negative element** (the dispersive lens),

the latter always having a shorter focus than the former.

The two optical elements are screwed into the ends of the **tele-photographic tube-mount,** which is longitudinally adjustable and fits the threads of the screws of the objective collars. The distance of the positive from the negative element may thus be varied, the minimum being equal to the difference in focal length existing between the two components. An adjustable diaphragm is fitted between the lenses.

When the distance between the two elements is exactly equal to their difference in focal length, the tele-objective forms a so-called telescopic combination and represents an objective of abnormally long focus. The focus shortens in proportion to the increase of the distance, so that, by appropriate adjustment, an objective of any desired focus may be produced and applied to photographic purposes.

The characteristic construction of the tele-objective invests it with the following three attributes which are most important from the point of view of photography:

1. The tele-objective affords an extraordinarily wide range of foci.
2. The camera extensions being equally short in both cases, the tele-objective yields a more natural perspective than the ordinary photographic objective where large figures (portraits, &c.) form a feature of the picture.
3. The required camera extension is very small in proportion to the resulting equivalent focus of the tele-objective and amounts, in fact, to only a fraction of the focal length when the tele-objective is focused for very distant objects. This fraction is approximately expressed by the formula $\frac{\text{Focus of negative lens}}{\text{Focus of positive lens}}$ $(= \frac{1}{\gamma}$, γ being the symbol for magnification).

These three characteristics render the tele-objective eminently suitable for taking **large portraits, views of distant landscape,** and **architectural details.**

The nature of the work required must decide the choice of the objective, which may be either the **tele-positive** used as a single lens, or an anastigmatic double objective. The negative element is supplied by a specially constructed dispersive lens, viz: the **Tele-negative.**

Although possessing the particular advantageous features mentioned, in regard to correction the tele-objectives naturally fall behind any well corrected photographic lenses of the ordinary construction. Tele-objectives are not so rapid, yield less brilliance and precision of picture, and afford only a restricted field (cover small plates only). We should add that a certain amount of skill and practice is required for working with the tele-objective.

According as an objective of large or small focus (large or small diameter of lenses) is employed as positive element, a correspondingly large or small tube-mount and a negative lens of correspondingly long or short focus must be available.

The adoption of the **larger dimensions** gives the tele-objective, the resulting foci otherwise being equal, a greater degree of rapidity, as well as providing for objects at a great distance and requiring less camera extension. It is therefore advisable to use the larger sizes whenever it is necessary to work with a long focus, when, for instance, objects to be photographed are at extremely long distances (balloons, mountain scenery, &c.), or when extraordinarily large portraits (heads up to natural size) are to be taken.

The magnification (γ) is a factor which exercises great influence on the quality and extent of the are a of the sharp field. With otherwise equal equivalent foci, equal conditions of aperture, and identical positive elements in different tele-objectives, the area of the field and of the sharp image will generally be smaller, the greater the amount of γ in the objective selected.

For fuller details as to the working of our tele-objectives we would refer to the pamphlet ***"A Monograph on the Nature and Application of Tele-photographic Objectives by Dr. P. Rudolph, Jena, Augt. 1896."***

Bibliography:

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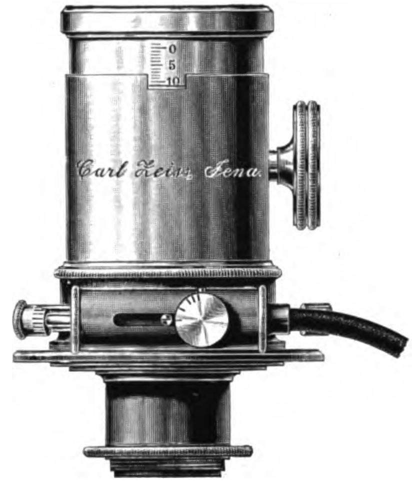
„ „ „ „ „Zur Geschichte und Theorie des photographischen Tele-Objectivs". D. Phot. Bibl., vol. V. Weimar, K. Schwier, 1897. II, 41 p. 8°.

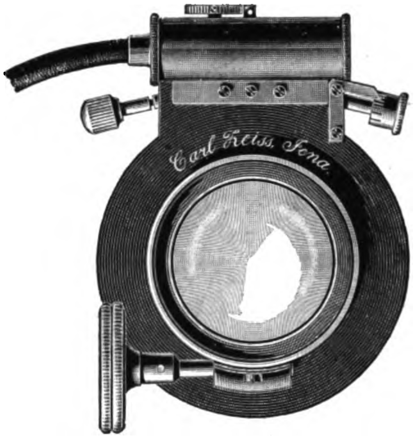
Th. R. DALLMEYER: „Telephotography". London, William Heinemann, 1899.

Carl Zeiss, Optische Werkstaette, Jena.

The Tele-photographic Tube-Mount.



Tele-photographic Tube-Mount III.
Set to optical interval $\Delta = 11$ mm.
($^1/_2$ full size.)
Side elevation.



Tele-photographic Tube-Mount III.
($^1/_2$ full size.)
Front view.

The length of our tube-mount is varied by means of a rack and pinion. The mount is short and, in order to ensure absolute steadiness of the whole apparatus during the exposure, we have adopted an automatic iris-shutter instead of the ordinary iris-diaphragm.

The mount is provided with a millimetre scale, on which variations in length may be read off; when the index points to 0, the tube is at its shortest length. The important advantage of this scale consists in the facility with which the **resulting focal length of the tele-photographic combination** corresponding to any tube length, as indicated by the scale, may be accurately calculated, or found from the **Tables** contained in the directions supplied with the objectives.

The positive element screws into the inner movable tube at the front of the mount, either directly or by the interposition of an adapter. The negative element is attached, by means of an adapter, at the opposite (the camera) end.

These adapters, if supplied as parts of a given combination, are adjusted in such a manner that when the tube-mount is in its shortest position, the tele-objective acts as a telescopic combination, having an extraordinarily long focus.

We make two regular sizes (III and IV) of the tele-photographic tube-mount as described above, at the prices shown in the subjoined table. Tube-mount V is made to order only, at prices varying according to special requirements in each case.

Tele-photographic Tube-Mount.

No.	Description	Code-word	Price	Internal Diameter		Length of Tube excl. of Adapter		Greatest available variation of Length		No.
			$	mm	in.	mm	in.	mm	in.	
1	Tube-mount III fitted with automatic Iris-shutter No. 2	**Ration**	35.—*	49	2	76	3	20	$^3/_4$	1
2	Tube-mount IV fitted with automatic Iris-shutter No. 5	**Ratte**	63.—*	82	$3^1/_4$	113	$4^1/_2$	30	$1^1/_4$	2
3	Tube-mount V			135	$5^1/_4$	186	$7^1/_4$	60	$2^3/_8$	3

Tube-mount Adapters for a double-objective combination
Price, $ 2.— to $ 3.50 per set.

Tube-mount V is made and supplied to order only.

* If **specially ordered,** Tube-mounts III and IV may be fitted with ordinary Iris-diaphragms instead of Automatic Iris-shutters at a reduction of $ **10.50** from the prices quoted above.

Positive Components for Tele-photographic Objectives.

In all cases where it is imperative that there should be no distortion of straight marginal lines as, for instance, in the details of architecture, the positive element should be a well corrected **rapid photographic doublet.** Our rapid Protars, more particularly those of Series II^a, III^a and VII^a, as also our Unar, are well adapted to satisfy all requirements.

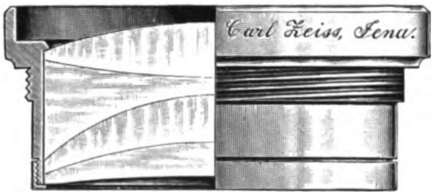
When, however, it is of special importance that the lens should be particularly rapid and possess a large and clear field, as in the case of portraiture and in photographing balloons and mountain scenery, where a slight degree of distortion at the edge is of less moment, the choice of a positive element should fall on the **Tele-positive.**

Tele-Positive.

German Patent No. 88889.

A single objective, composed of four single lenses, serving as positive element of Tele-photographic Combinations, and as a Rapid Portrait Lens.

Relative Aperture 1 : 3.



Tele-positive No. 1 $f = 135$ mm.
(Full size.)

Our Tele-positive is an extra-rapid single objective, consisting of four elementary components cemented together, and possessing very superior spherical correction. Its relative aperture is $F = 3$ and is fully utilized in the tele-photographic combination. Its peculiar construction, by which this result has been achieved, has been patented at home and abroad.

Though primarily intended to serve as the positive element of a tele-photographic objective, this tele-positive may also be employed with advantage as a rapid studio lens for small pictures. Its relative aperture suffices for shortest exposures in the studio, and its covering power is sufficient to render it available for single portrait heads.

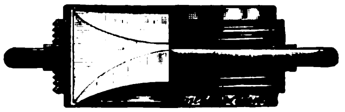
We make the following three sizes of this Tele-positive:

No.	Code-word	Price	Diameter of Lenses		Focus		Adapted for Tele-photographic Tube-mount	Form of portraits (heads) obtainable at full aperture
		$	mm	in.	mm	in.		
1	**Raffinade**	**47.—**	45	$1^{3}/_{4}$	135	$5^{1}/_{4}$	III	Mignon
2	**Raphael**	**139.50**	75	3	225	$8^{3}/_{4}$	IV	Carte de Visite
3	**Reaction**	**348.50**	125	5	375	$14^{3}/_{4}$	V	Cabinet

Tele-Negative.

A Negative Element for Tele-photographic Combinations, which may be combined with both single lenses or double objectives.

The Tele-negative consists of three elementary lenses cemented together. It possesses a very large aperture as compared with its focal length, the diameter of the lenses being just about one half of the latter. Any tele-photographic combination of which it is a component possesses therefore a comparatively large field. Owing to its inherent superior spherical and chromatic correction it forms, in conjunction with an equally well corrected positive element, a tele-photographic combination of excellent optical and photographic qualities.



Tele-Negative No. 2, $f = -45$ **mm**
(Full size.)

One and the same tele-negative suffices to produce the best possible results, both when used in conjunction with a tele-positive, or with a double objective. It is only necessary to remember the following rules respecting the manner in which the tele-negative should be attached to the tube-mount. If it is to be used with the **tele-positive,** it should be screwed into the tube-mount with the engraved edge of its mount farthest from the tele-positive; but if a **photographic double objective** supplies the positive element, the engraved edge of the mount of the tele-negative should be nearest to the positive element. For this purpose the mount of the tele-negative is provided with screw threads at both ends.

We make six sizes of tele-negatives of this description, prices and particulars of which will be found in the table below.

Tele-Negative.

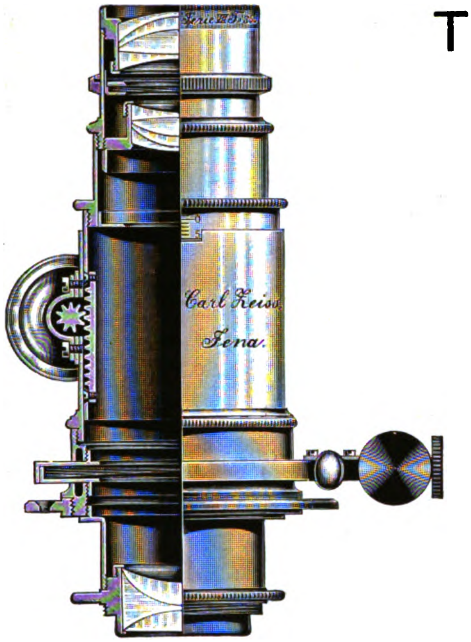
Adapted for combination both with the Tele-Positive or with a Double Objective.†)

No.	Code-word	Price	Diameter of Lenses		Focus		Adapted for Tube-mount
		$	mm	in.	mm	in.	
1	**Realitas**	**14.—**	15	5/8	27	1	III*
2	**Record**	**17.50**	24	1	45	1 3/4	III*
3	**Regulus**	**24.50**	30	1 1/4	58	2 1/4	III*
4	**Remedium**	**35.—**	37	1 1/2	75	3	IV*
5	**Reptilia**	**52.50**	50	2	100	4	IV*
6	**Relais**	**77.—**	63	2 1/2	125	5	V*

*) The tele-negative may, if desired, also be adapted to any other suitable tube-mount. There will then be an extra charge for the requisite adapter.

†) If used in conjunction with a single **tele-positive,** the engraved side of the **tele-negative** should be **away from** the positive lens; but if combined with a **double objective,** the tele-negative should be screwed into the tube-mount with its engraved end **nearest** the positive element.

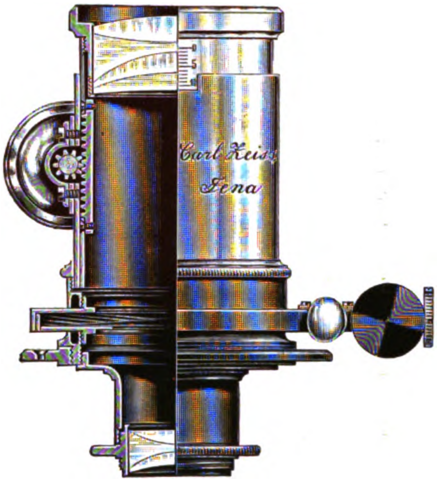
Tele-photographic Combinations.



Tele-Objective A_5.
Composed of Tube-mount III, Double-Protar $f_1 = 179$ mm, and Tele-negative $f_2 = -58$ mm
Optical interval $(\Delta) = 5$ mm;

$$f = \frac{179.58}{5} \text{ mm} = 207.6 \text{ cm}.$$

(About $^1/_2$ full size.)



Tele-Objective A_1.
Composed of Tube-mount III, Tele-positive $f_1 = 135$ mm and Tele-negative $f_2 = -45$ mm.
Optical interval $(\Delta) = 11$ mm;

$$f = \frac{135.45}{11} \text{ mm} = 55 \text{ cm}.$$

(About $^1/_2$ full size.)

According to the special requirements in each case the tele-photographic objective, as constructed with the aid of our tele-photographic tube-mount, should consist of either

1. the combination of a rapid photographic double objective (Series I^a, I^b, II^a, III^a or VII^a) with one of our tele-negatives corresponding to the focus of the objective selected (see the first of the above illustrations),

or

2. of a tele-positive combined with a suitable tele-negative. An example of this combination is given in the second illustration at the head of this page.

A combination answering the first description (a photographic double objective forming the positive element) is preferable if the tele-objective is to be applied to universal purposes — architecture, landscape, portraits, relief objects, &c. But when special importance is attached to rapidity, a combination of the other category, in which the tele-positive supplies the positive element, should rather be chosen. It should, however, be borne in mind that a combination of the second description embodies certain defects and that, in the case of architectural details or similar work, it is only available for the production of small pictures, when, moreover, the angle involved must be small. (See p. 90 Positive components of Tele-photographic Objectives.)

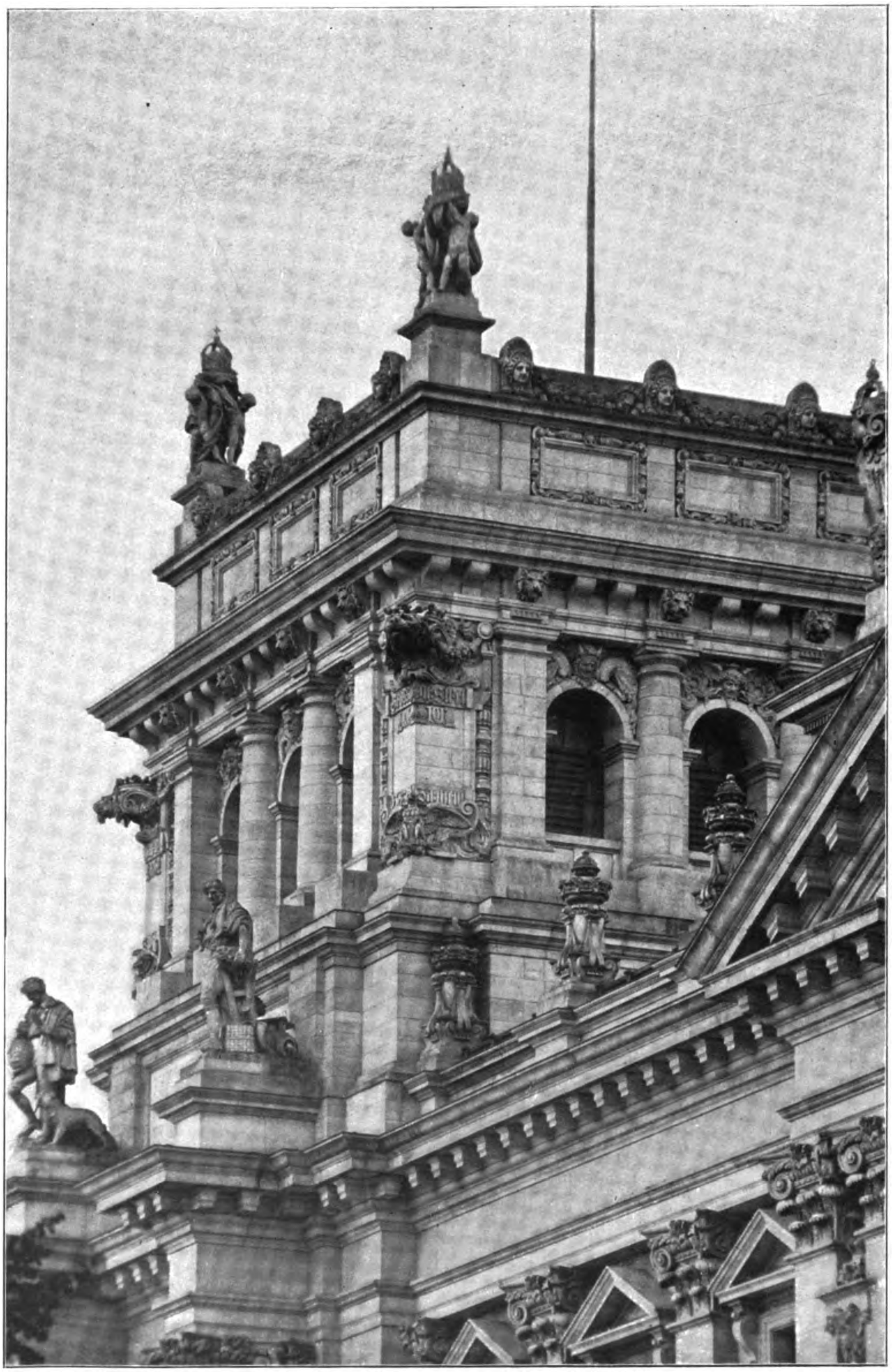
Specifications of Tele-photographic Combinations.

A. Tele-photographic Objectives adapted for Tube-mount III.

No.	Code-word	Price	Positive Element			Negative Element		Ratio of Foci (Magnification γ)	Size of Plate covered with camera extension of about 30 cm (about 12 inches)		Nature of Work
			Description of Lens	Focus		Focus					
		\$		mm	in.	mm	in.		cm	in.	
1	**Resonator**	**99.50**	Tele-positive	135	$5\frac{1}{4}$	45	$1\frac{3}{4}$	3.0	13×18	$5\frac{1}{8} \times 7$	Landscapes and large portraits (short exposure)
2	**Retina**	**106.50**	Tele-positive	135	$5\frac{1}{4}$	58	$2\frac{1}{4}$	2.3	13×18 to 16×21	$5\frac{1}{8} \times 7$ to $6\frac{1}{2} \times 8\frac{1}{4}$	
3	**Rosmarin**	**115.—**	Protar $^1/_8$, Ser. II^a, 4.	205	8	58	$2\frac{1}{4}$	3.5	13×18	$5\frac{1}{8} \times 7$	Landscapes and architectural views (long exposure)
4	**Rosso**	**106.50**	Protar $^1/_9$, Ser. III^a, 4.	196	$7\frac{3}{4}$	75	3	2.6	13×18	$5\frac{1}{8} \times 7$	
5 †	**Rotator**	**136.—**	Double-Protar, Ser. VII^a, 8.	179	7	58	$2\frac{1}{4}$	3.0	13×18	$5\frac{1}{8} \times 7$	
6 †	**Rubens**	**153.50**	Double-Protar, Ser. VII^a, 10.	200	8	75	3	2.7	13×18	$5\frac{1}{8} \times 7$	
7 †	**Ruptura**	**166.—**	Double-Protar, Ser. VII^a, 11.	216	$8\frac{1}{2}$	75	3	2.9	13×18	$5\frac{1}{8} \times 7$	

† These combinations may not be imported into France commercially.

A short delay is unavoidable in the execution of orders for any of the combinations specified in Tables A and B. Existing parts of a combination must be forwarded to us for adaptation if it be desired to utilize them.



Reichstag Building, Berlin.

Carl Zeiss, Optische Werkstaette, Jena.

B. Tele-photographic Objectives adapted for Tube-mount IV.

No.	Code-word	Price	Positive Element			Negative Element		Ratio of Foci (Magnification γ)	Size of Plate covered with camera extension of about 40 cm (about 16 inches)		Nature of Work
		$	Description of Lens	Focus mm	Focus in.	Focus mm	Focus in.		cm	in.	
1	**Rubin**	**237.—**	Tele-positive	225	9	75	3	3.0	18×24	$7 \times 9^{1}/_{2}$	Landscapes and large portraits (short exposure)
2	**Rubrik**	**254.50**	Tele-positive	225	9	100	4	2.3	18×24	$7 \times 9^{1}/_{2}$	
3	**Rumor**	**244.—**	Protar $^{1}/_{8}$, Ser. II^{a}, 7.	350	$13^{3}/_{4}$	100	4	3.5	16×21	$6^{1}/_{2} \times 8^{1}/_{4}$	Landscapes architectural views (long exposure)
4	**Rundung**	**303.50**	Protar $^{1}/_{8}$, Ser. II^{a}, 8.	433	17	125	5	3.5	16×21	$6^{1}/_{2} \times 8^{1}/_{4}$	
5	**Rune**	**247.50**	Protar $^{1}/_{9}$, Ser. III^{a}, 8.	407	16	125	5	3.3	16×21	$6^{1}/_{2} \times 8^{1}/_{4}$	
6 †	**Russe**	**307.—**	Double-Protar, Ser. VII^{a}, 19.	337	$13^{1}/_{4}$	100	4	3.4	16×21	$6^{1}/_{2} \times 8^{1}/_{4}$	
7 †	**Ruthene**	**361.—**	Double-Protar, Ser. VII^{a}, 20.	364	$14^{1}/_{4}$	125	5	3.0	16×21	$6^{1}/_{2} \times 8^{1}/_{4}$	

†) These combinations may not be imported into France commercially.

The resulting foci being equal, the tele-photographic objectives in Tube-mount IV work with greater rapidity than those in Tube-mount III, specified in Table A. Also, magnification (γ) being the same, they require a greater distance of the object and a shorter camera extension.

Tables A and B show only a few combinations of special merit for general purposes, but we are prepared to supply, to order, any other combination practicable.

Colour Screens for Landscape Photography.

Excessive and unnatural contrasts, produced in the negative by differences in colour and variations in intensity of illumination over the landscape, may be toned down by the interposition between landscape and lens of a coloured disk, yellow being the colour most generally used. We supply such yellow screens in three different tints, viz: light, medium and dark. In comparison to the period of exposure demanded when working without them, the exposure, when using the screens, is prolonged about 5, 10 and 15 times respectively. If specially desired, we are prepared to supply screens of other colours at prices but slightly in excess of those charged for the yellow screens recommended by us.

The material employed in the manufacture of these screens being carefully selected coloured plate-glass, we can guarantee that the difinition required in landscape photography will not be interferred with by the interposition of the glasses. For copying processes we would, however, recommend the light-filters described on page 112, which are carefully ground and are perfectly plano-parallel.

The glass disks are mounted in a brass ring, lined with velvet, by means of which they can be slipped over the front of the lens mount.

The following sizes are regularly kept in stock:

Yellow-Screen mounted to slip on lens hood		Adapted for lenses in our Standard Mounts	
Code-word **light, medium or dark**	Price $	No.	
Antacida	1.10	0	Larger sizes to order and at special rates
Antaeus	1.80	I	
Antea	2.—	II	
Antidosis	2.10	III	
Antigone	2.30	IV	
Antisepsis	2.50	V and Tele-positive 1	
Antistes	2.80	VI	
Antithesis	3.20	VII and VIII	
Antonius	3.50	IX to XI	

Yellow screens are particularly useful for landscape views interspersed with dark arborial groups and light buildings, and for landscapes with distant background; also for mountain scenery with snow-clad summits and glaciers, and for winter landscapes. This applies equally to ordinary and orthochromatic plates.

In ordering colour screens the number of the tube-mount and of the objective should be given.

Optical Appliances

for photo-mechanical printing processes.

The appliances for photo-mechanical printing processes specified in the succeeding pages are subjected to a very careful examination in our own **Reproduction Laboratory.** We are thus in a position enabling us to guarantee the absolutely faultless condition of every single lens, prism, light-filter, &c. supplied by us. If an individual customer should fail to obtain satisfactory results, it may safely be assumed that the failure is due to some misconception as to the method of using the particular appliance. In such cases we shall most gladly assist by explicit advice and afford every facility for local instruction in our own laboratory.

We are also prepared to supply — to order and at prices to be fixed by special agreement — any copying lenses not included in this catalogue, which may be required for some specific purpose or for the production of exceptionally large sizes of pictures.

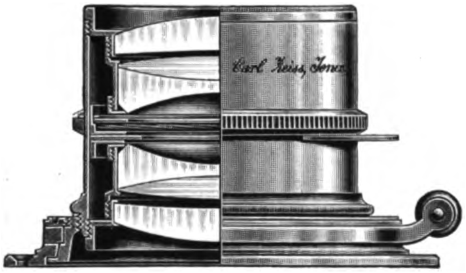
Copying Lenses.

For copying purposes it is advisable to use lenses having comparatively **long foci.** When, as is generally the case, full-sized copies are required, the objective should be placed at a distance equal to double its focal length from the object. It is desirable that, in comparison to the dimensions of the original, this distance should not be excessively small, as otherwise considerable difficulty will be encountered in obtaining sufficient and uniform illumination of the original and in setting the plane of the latter at right angles to the axis of the objective. A focal length equal to the extreme diagonal of the object, or of the plate, may be regarded as the requisite minimum.

An objective designed for copying engravings has to satisfy very different requirements from one intended to be used for half-tone process work. — For copying engravings the objective should possess particularly good definition. When copying in full size, the greatest requisite degree of sharpness should be obtainable at 1:25 to 1:30, since any further stopping would rather tend to interfere with the sharpness of the definition through the effect of diffraction, than to improve results. This requirement is satisfied by suitable numbers of Series I^a, I^b, II^a, III^a and V. — For copying half-tones, autotype, and for three colour printing great rapidity should be a prominent feature of the objective used. Series I^a, I^b, II^a, III^a and VII^a are therefore particurlarly suitable for these purposes.

Focusing. With all the rapid copying lenses at present in use it is desirable and advisable **to focus with the same stop with which the photograph is to be taken.** The objectives of Series I^a, which show no appreciable difference in focus under varying conditions of stopping, are the only exception to this rule. In the case of engravings, where the highest degree of precision is wanted, it may not even be superfluous to obtain the best focusing by a series of experiments.

System of diaphragms for copying lenses. Unless otherwise ordered, we supply our copying lenses fitted with sliding diaphragms having an axial movement of 45°, so that, when the special form of stop with other than circular openings (so generally adopted in connection with autotype processes) is being used, the openings of these stops may be readily adjusted in correct relation to the lines of the cross-wire screens. Sometimes, however, it will be found advantageous to have an iris-diaphragm available as well as the sliding one. The illustration above represents a Planar fitted with a diaphragm combination of this description, as also with a revolving collar. The latter is an indispensable adjunct to a copying lens if a reversing prism is to be used in conjunction with it.



Copying Lens

fitted with **combined** iris- and **revolving** sliding diaphragm and **adjustable** revolving collar.

Copying Lenses.

No.	Series and No.	Objective in Brass Mount fitted with **Sliding** stop*)		Focus		Size of Plate covered						Nature of Work
		Code-Word	Price $	mm	in.	stop 1:	cm	in.	stop 1:	cm	in.	
1	Iᵃ, 17	**Real**	**348.50**	470	18½	7	24×30	9½×11¾	12	30×40	11¾×15¾	From Stop 1:7 upwards sufficient precision for Engravings
2	Iᵃ, 18	**Rebe**	**697.—**	610	24	7	30×40	11¾×15¾	12	40×50	15¾×19½	
3	IIᵃ, 8	**Redan**	**160.50**	433	17	9	18×24	7 × 9½	18	24×30	9½×11¾	At 1:8 to 1:18 Half-tone, Autotype and Three colour printing; at 1:18 to 1:30: Engravings and Etchings.
4	IIIᵃ, 9	**Reform**	**139.50**	505	19¾	10	18×24	7 × 9½	18	24×30	9½×11¾	
5	IIIᵃ, 10	**Regula**	**174.50**	600	23½	10	24×30	9½×11¾	18	30×40	11¾×15¾	
6	IIIᵃ, 11	**Rekrut**	**226.50**	690	27	10	30×40	11¾×15¾	18	40×50	15¾×19½	
7	V, 8	**Reporter**	**85.50**	460	18	25	18×24	7 × 9½	30	24×30	9½×11¾	
8	V, 9	**Reseda**	**125.50**	632	24¾	25	24×30	9½×11¾	30	30×40	11¾×15¾	
9	V, 10	**Revolte**	**247.50**	947	37¼	25	40×50	15¾×19½	30	50×60	19½×23½	

*) The prices quoted include only a set of 4 stops with round openings. Stops having other forms of openings, which form the subject of the next chapter, are charged for separately. Combined sliding and iris-diaphragms are fitted to order, at prices varying, according to the size of the objective, from **$ 5.50** to **$ 17.50**. The higher rate includes a set of 4 sliding stops with square openings.

Copying lenses for special purposes, not specified in our catalogue, are supplied to order and at special rates. We request that in such cases application may be made to us direct.

We specially desire to call attention to

our Planars with reduced secondary spectrum

which, as already pointed out in another place, are absolutely the best objectives at present existing for copying engravings and for three colour printing.

Special Stops for Autotype Printing.

Construction of Stops. For making ordinary reproduction-negatives stops having circular openings are generally most suitable, and as the size of the openings must vary according to the scale of reproduction, the size of the plate, and the nature of the original, the iris-diaphragm is best adapted for general purposes. Other conditions, however, prevail in autotype printing, which necessitates the use of a cross wire screen. Here it becomes necessary, in order to obtain the various effects, to employ stops with openings which deviate in one form or other from the circular shape. Openings of the most diverse patterns have been proposed but, whether owing to different methods of working or to the great variety of requirements entailed by different classes of work, the fact remains that a definite form has not yet been generally agreed upon. Our object being to dispense with complicated mechanism, we propose to fit to the tube-mount of the objective an arrangement of sliding stops — so called **"Pattern Stops"** — and thus provide a selection of openings, each of them departing from the circular shape in its own distinctive manner.

Until quite recently circular stops with only one opening, the centre of which coincided with the axis of the objective, were the rule. These we will, for convenience, call **"Monocular Stops".** So far as we know, DEVILLE was the first to introduce stops with more than one opening — the **"Coincidence Stops"** of Dr. GREBE*) — for autotype processes in which cross-wire screens are employed. When used with very rapid objectives, our Planars for instance, these new stops confer the advantage of reducing the required period of exposure to one fifth or less.

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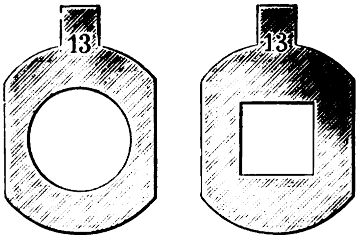
*) Dr. C. GREBE: „Das autotypische Negativ und die Verwendung sehr lichtstarker Objective zur Herstellung desselben.“ Phot. Corr. 1899, pp. 241 et seq. We shall be glad to supply reprints of this paper gratis and postfree on application.

Monocular Stops. Our regular manufacture of monocular stops is restricted to the circular and square patterns illustrated below under *a* and *b*. The size of the openings depends on the wishes of customers and on the nature of the objectives with which they are to be used. They are not, therefore, made of a uniform pattern for all lenses alike. To enable the operator to ascertain the size of the opening quickly, we show on the face of each stop in millimetres the diameter of the circle in which its opening is inscribed. We have called this diameter of the opening the **"dimension of the monocular stop."**



a *b*

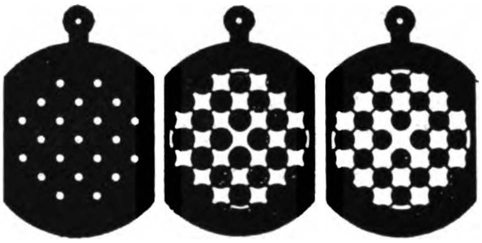
Monocular Stops.

a Circular stop. *b* Pattern stop.

Dimensions of stops = 13 mm ($^1/_2$ in.)

The **prices** of monocular stops vary according to the sizes of lenses and the shape of the openings. Those illustrated above range from **$ 0.70** to **$ 2.10** according to size of objective.

Coincidence Stops. In producing autotype negatives by the use of cross-wire screens the method of divided exposure is most generally employed, i. e., stops of different diameters of openings (with small, medium and large openings) are successively inserted. Understanding by **"dimension of the coincidence Stop"** the distance from each other of the centres of two adjoining openings, which is the same throughout the field of each stop, three coincidence stops of similar dimension, but with graduated openings, are required for the production of autotype negatives. Such a set of 3 coincidence stops is shown in the illustration on the next page.



Set of Coincidence Stops.
Dimension about 3.5 mm ($^1/_8$ in.).

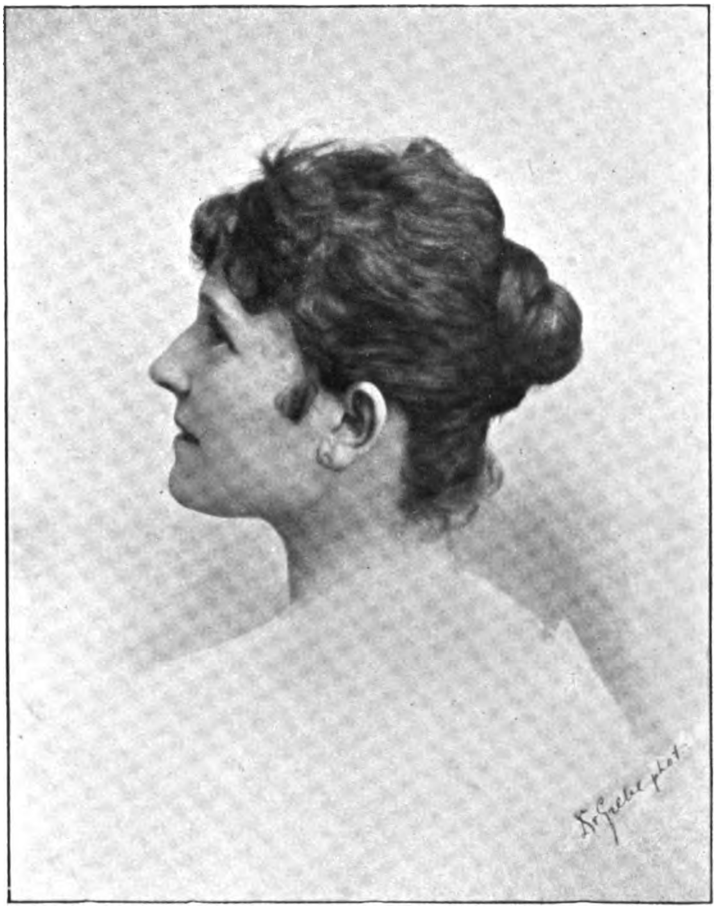
No. 1 of above coincidence stops possesses the smallest openings of the three and stands for the shade stop, No. 2, with medium-sized openings, is the middle-tone stop, No. 3 the final.

The price of a set of coincidence stops depends on the size of the objective and on the number of openings in the field of the stop. For objectives of medium size the price would be from **$ 5.50** to **$ 10.50** per set of three as illustrated above.

If an objective of the Planar type, Series I^a, is to be fitted with coincidence stops, we beg to be supplied with precise particulars as to the maximum size of plate, the scale of reduction, the size of the mesh of the wire screen, and the minimum distance at which the screen is available for working with the existing camera.

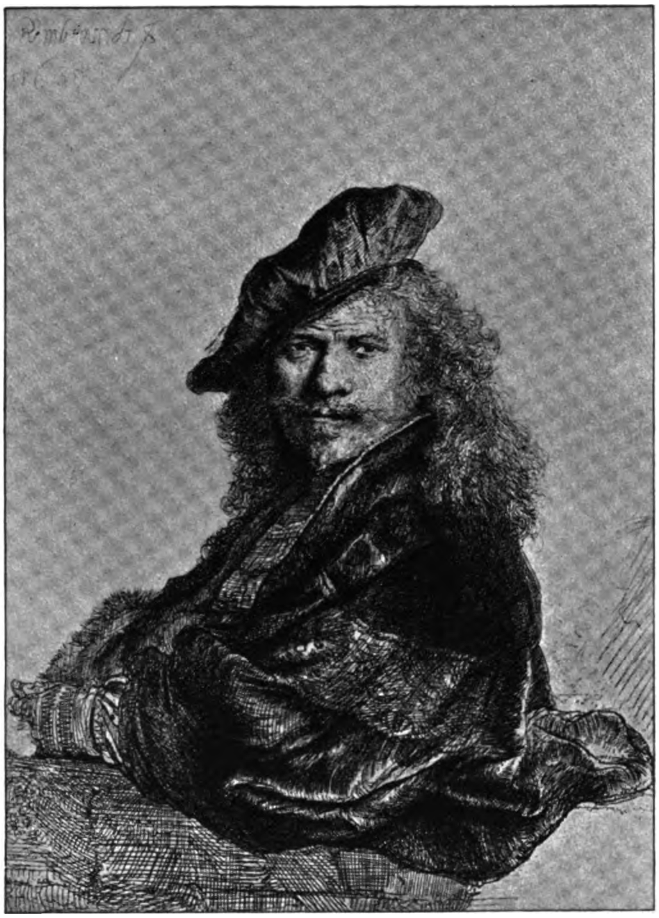
To ensure true execution it is desirable that means should exist for accurately adjusting the position of the screen in relation to the sensitive plate.

A specimen autotype, produced with a set of Coincidence stops and Planar $^1/_5$ $f = 610$ mm (24 in.), Series I^a, No. 18, appears on the next page.


Dr Grebe phot.

Autotype

produced with a set of Coincidence Stops and Planar 1/5
$f = 610$ mm (24 in.).


Rembrandt f.

Autotype after an Etching, done with the "Planar".

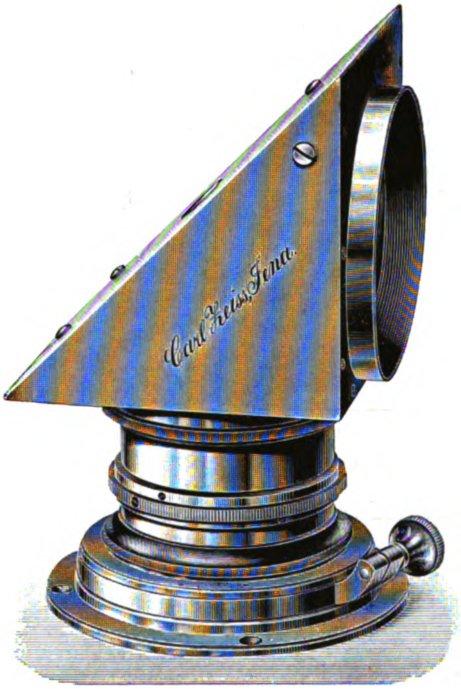
Carl Zeiss, Optische Werkstaette, Jena.

Reversing Prisms.

These prisms are made of carefully annealed and colourless crown glass; they are ground accurately rectangular and the reflecting surface is well silvered to ensure complete reflection.

The prism casing screws directly to the front of the lens mount so as to place one of the non-reflecting prism surfaces into close proximity to the front lens. By this means the prism is fully utilized.

For subsequent adaptation of a prism to an existing objective it is absolutely necessary that the latter be sent to our Works. We supply our prisms accurately centred with respect to the objective.



Protar 1 : 18, $f = 632$ mm (25 in.)
fitted with Prism No. 4 and Revolving Collar No. 3.
($^1/_2$ Full Size.)

To ensure accuracy and comfort in working with a prism when attached to an objective, the use of an adapter with revolving collar and clamp is indispensable. By means of such an adapter the objective, with its prism, can be turned on its own axis in any desired direction and secured by the clamp when the prism is in proper relation to the object to be copied. The prices and dimensions of adapters regularly manufactured by us are stated in the table on the next page.

The subjoined table contains the particulars and prices of prisms which we usually keep in stock. The table also indicates the numbers of our copying lenses for which the various prisms are adapted. It may be taken for granted that the lenses in conjunction with the corresponding prisms cover an angle of 25 to 35° with medium stops.

The prisms are also adaptable to any other of our objectives the series and numbers of which are not included in the table.

Reversing Prisms.

No.	Code-Word	Price incl. adaptation to Objective	Length and Breadth of non-reflecting surfaces		Adapted for Objectives of Series					
		\$	mm	in.	I^{a} No.	I^{b} No.	II^{a} No.	III^{a} No.	V No.	VII^{a} No.
1	**Saeculum**	**23.—**	25	1	7	—	1, 2	1, 2	1, 6	1, 2
2	**Sago**	**33.—**	35	$1^{3}/_{8}$	8, 9	3	3, 4	3,4,5	7	3—8
3	**Salamis**	**42.—**	46	$1^{7}/_{8}$	10, 11	4,5,6	5, 6	6, 7	7^{a}, 8	9—14
4	**Saturn**	**73.—**	60	$2^{3}/_{8}$	12	7	7	8	9	15—17
5	**Seneca**	**118.50**	75	3	13	8	8	9	10	18—22
6	**Sonate**	**174.50**	90	$3^{1}/_{2}$	14, 15	9, 10	—	10	—	25
7	**Stadium**	**253.—**	105	$4^{1}/_{8}$	16, 17	—	—	11	—	28
8	**Supremum**	**453.—**	125	5	18	—	—	12	—	30

We also undertake to adapt our prisms to the lenses of other makers, but they must be sent to us for this purpose. The charges in such cases will be at special rates, varying from about 5.50 to 10.50 $, according to the size of the objective and the work required to effect the adaptation.

To enable one to turn the objective (with its prism) in any desired direction and to secure it after proper relation has been established between prism and object for reproduction, recourse is had to a revolving collar, which we manufacture in the sizes shown in the table below.

Flanges fitted with Revolving Collars and Clamps.

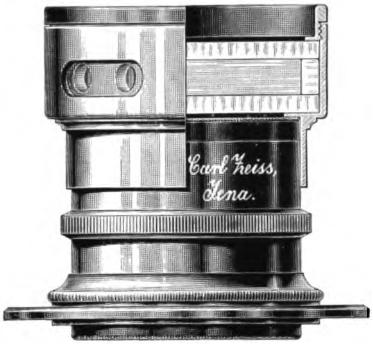
No.	Code-Word	Price $	Adapted for Objectives of Series					
			I^a No.	I^b No.	II^a No.	III^a No.	V No.	VII^a No.
1	**Drehber**	10.—	7	—	1, 2	00—2	3, 4, 5, 6, 7	0—2, 4
2	**Dredge**	10.50	8, 9	3	3, 4	3, 4, 5	7^a, 8	1—8, 10
3	**Dreget**	12.—	10, 11	4, 5, 6	5, 6	6, 7	9	7—14, 16
4	**Drehkran**	14.—	12	—	7	8	—	—
5	**Drehkul**	17.—	—	7	8	9	10	15, 17, 19
6	**Drehling**	19.50	13	8	—	10	—	18, 20, 22
7	**Drehwurm**	21.—	14	9	—	—	—	25
8	**Drempel**	26.—	15	10	—	11	—	28
9	**Drepanon**	28.—	16, 17	—	—	12	—	30
10	**Drewenz**	43.50	18	—	—	—	—	—

Unless distinctly ordered otherwise we supply an flange with each objective fitted with a prism and charge according to above rates.

Light-Filters.

Light-filters serve as receptacles for coloured fluids and are employed in the production of coloured copies.

Our light-filters consist in their essential parts of two circular plano-parallel glass disks, which are united by a narrow glass ring so as to form a cell. In the ring are two openings and through these the cell is filled whith any solution required. The whole is contained in a brass mount, made to slip on the hood of the objective.



Light-filter No. 1 fitted to Ser. V, No. 9.
(3/5 Full Size.)

To facilitate the process of cleaning the plates after using them, it is advisable not to permanently seal them with mastic but to join them temporarily by the application of a little vaseline.

Any light-filter which shall not impair the optical quality of the image should in every respect be as perfectly made as the lenses themselves. The glass disks must therefore be perfectly plane and made of uniform and unstrained glass, which accounts for the comparatively high price.

Light-Filters.

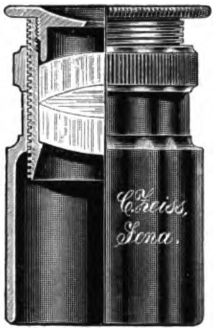
No.	Code-word	Price	Diameter of Glass Disks		Adapted for Standard Lens Mounts
		$	mm	in.	No.
1	**Tabor**	**35.—**	60	2 3/8	III, IV, V, VI.
2	**Talisman**	**49.—**	80	3 1/8	VII, VII, IX, X.
3	**Tantalus**	**97.50**	110	4 1/4	XI, XII.
4	**Tombola**	**160.50**	140	5 1/2	XIII, XIV, XV.

For adaptation to an existing objective it is absolutely necessary that the latter should be forwarded to us, as otherwise we cannot accept responsibility as to satisfactory centring.

Focusing Glass.

The focusing glass here recommended is primarily intended for viewing **transparent objects,** thus for sharply focusing the picture on the ground glass screen, or for testing negatives required for copying processes as to their precision and quality.

We supply this lens in the form of mount depicted in the appended illustration, and in three magnifying powers, i. e., × 6, × 10 and × 16. The first and second are preferable for focusing, the second and third for the examination of negatives.



Focussing Glass No. 1
(6 x)
(about $^3/_4$ Full Size).

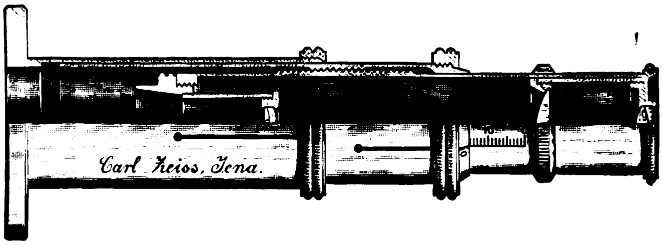
Directions for using the Focusing Glass. Unscrew the milled clamping ring (by moving it upwards in the direction of the projecting edge of the mount). The glass is then placed upon the ground glass focusing screen, or the negative to be examined, and the lens is sharply focused by screwing the cell in or out by means of its projecting upper edge. Subsequent disturbance is prevented by carefully screwing the clamping ring back again.

Prices of the Focusing Glass.

No.	Code-Word	Price	Diameter of Lenses		Focus		Magnification at distance of 10"
		$	mm	in.	mm	in.	
1	**Luchs**	9.—	21	$^7/_8$	42	$1\,^5/_8$	6
2	**Lucifer**	9.—	11	$^1/_2$	25	1	10
3	**Lucrum**	9.—	9	$^3/_8$	15	$^5/_8$	16

Focusing Microscopes.

In many cases it is found that the ordinary focusing glass fails to satisfy the requirements of copying processes. Sometimes the magnification is not sufficient, or inconvenience may be experienced in using the lens owing to the necessity of having to bring the eye so close to the object under examination. The **Focusing Microscope** obviates both faults, as it has a magnifying power equal to about 28 diameters and allows of the eye being kept at a convenient distance from the object.



Focusing Microscope.
(About $^1/_2$ full size.)

Our focusing microscope is provided with a double action for rough and fine focusing. Take up the instrument, holding it firmly with the left hand between the base plate and the nearest milled clamping ring (at the place in the illustration where "Carl Zeiss, Jena" appears), and loosen the clamping ring. Then, seizing the tube with the right hand at the fixed milled band above the 0 mark of the millimetric scale, proceed to effect the rough focusing by sliding the tube in or out of the sleeve held in the left hand. Having obtained the rough focus, screw the clamping ring up again. The fine focus is obtained by screwing the tube in or out of the second, or upper, sleeve. Before this can be done, the second clamping ring (situated on the $^1/_{10}$ *division outside of the tube) must be loosened. The millimeter scale on the tube, in conjunction with another graduation on the upper edge of the sleeve, enables one to read at a glance quantities as small as* $^1/_{10}$ *mm and to correctly estimate* $^1/_{100}$ *mm, so that the most minute differences of distance between two objects can be estimated almost down to* $^1/_{100}$ *mm.*

For the use of the same observer it is enough to do the rough focusing only once, and the most expeditious method would be to first of all put the tube, by means of the fine focusing action, to an intermediate position (say to 10 mm) on the millimetric scale.

This focusing microscope is an almost indispensable requisite for the finer classes of autotype work, in which it is necessary that the distance of the screen from the sensitive plate should be accurately maintained over the whole surface of the plate and which demand, in order to ensure precision, a careful adjustment of the autotypical point. The microscope will also render good service by affording ease and comfort in the examination of autotypical negatives.

Price of Focusing Microscope **$ 23.—.**

Code-word: **Lunula.**

Nature of Glasses employed by us.

We use exclusively silicate glasses whose permanency and power of resisting external influences have been amply tested in the course of many years. We carefully select our raw material and make a point of excluding glasses exhibiting objectionable flaws or showing signs of tension. We even endeavour to avoid, as far as possible, small bubbles and impurities in the glass, although such are really only *esthetic* defects. We would, however, remark that the peculiar and very advanced optical quality of our objectives necessitates in their manufacture the use of glasses possessing qualities which formerly were not available. Some of these glasses are required to have a very high refractive power and yet a low dispersion, others again must combine high dispersion with low refractive power. In glasses possessing such exceptional qualities it is **almost impossible to entirely exclude the presence of small bubbles and granules,** their production involving such extraordinary technical difficulties that small esthetic defects of this nature are really unavoidable. As every practical optician knows, defects of this kind do not affect the quality of the lenses, the only effect produced by their presence being an inappreciably small loss of light, which even in the most unfavourable cases does not amount to $^1/_{10}\,^0/_0$. Since it does not lie in our power to obviate these defects, we **cannot** regard their presence as a legitimate cause of complaint. We must, in fact, announce our inability to satisfy the requirements of those who, disregarding the most **essential** point, i. e., faultless working power of a lens, insist on this utterly **unimportant** feature.

Carl Zeiss, Optische Werkstaette, Jena.

Optical Tests.

Although we have adopted manufacturing methods which alone guarantee a high degree of uniformity in the quality of all our productions, an additional safeguard is provided by the most exhaustive tests to which all our opto-photographic appliances are subjected before being declared fit for the market. These tests are carried out in a photographic laboratory specially equipped for the purpose, and the methods vary according to the nature of the lenses. Objectives intended for landscapes and instantaneous and group work are examined by means of the **test-screen** proposed by Dr. P. RUDOLPH ¹), while copying lenses are criticized by the examination of an object showing particularly fine and crisp details.

For the demonstration of the comparative qualities of two objectives with reference to a third, and for the comparison of the merits of different individual lenses, we employ the **test-object for ganging depths of focus** ²) recommanded by Dr. P. RUDOLPH and described in various journals. We execute these latter tests only if specially required, subject to a charge equivalent to our own expenses. The same applies to test photographs of landscapes, instantaneous views, groups and portraits taken to special order.

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¹) Dr. P. RUDOLPH: "Die Zeiss-Anastigmate". Photographisches Wochenblatt, Berlin, 1892. Nos. 18—21.

²) id.: "Ueber eine neue Methode zur bildlichen Darstellung der Leistungsfähigkeit photographischer Objective". Atelier des Photographen, Halle, 1894, pp. 102 and
id.: „Ein neues Probeobject zur bildlichen Darstellung etc.". EDER's Jahrbuch, 1895, p. 145.
J. H. AGAR BAUGH: "Dr. P. RUDOLPH's Method of Lens testing and some of his results". Photographic Journal, 1895—6 (2) 20. p. 141—143.

Iris-Shutters for Time and Instantaneous Exposure.

Iris-Shutters, German Patents, Nos. 74652 and 101691.

These Iris-shutters are invariably fitted in the plane of the lens stops, hence in the case of double objectives they are mounted between the lenses.

They are made in our own workshops and particular attention is paid to solidity of workmanship. They are durable and as reliable as it is possible for a shutter to be. We are prepared to execute repairs at a minimum cost.

The iris-shutter serves at the same time as a shutter and as a variable stop, without imposing restrictions on their utility in either one respect or the other.

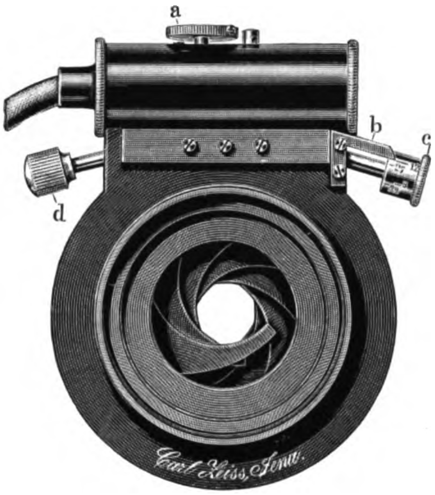
We make three forms of shutters modified for various requirements.

Incidentally it has been stated, though erroneously (see Photographische Mittheilungen, vol. 32, 1895/6, p. 6), that the iris-shutters cause the exposure to be greater at the centre than at the edge, the alleged reason of this being that the small openings act longer than the wide ones during the opening and closing of the iris-shutter. This objection would be justified, if we were to mount the iris-shutter immediately in front of the photographic plate. The opposite, however, takes place, since the shutter acts in the plane of the stops. The distribution of light from centre to margin is, in fact, better regulated than in any other form of shutter. In support of this argument we need only recall the fact that in all cases where a uniform exposure is required, as in wide-angle photographs, a narrow stop is used so as to obviate the partial stopping of wide pencils of rays caused by the edges of the lenses. From this it follows that the iris-shutter regulates the exposure at the edge in a very favourable manner, owing to this very fact of the narrow stops acting longer than the wide ones.

The iris-shutter acts therefore in a more rational manner than any other shutter which is **attachable to a lens.**

Another question is, whether any shutter attached to a lens is adapted to secure the best possible results whenever it is primarily required to completely utilize during the exposure the rapidity of the lens corresponding to a given maximum degree of stopping. The rejoinder must be, that this requirement is most completely satisfied by a slit shutter placed immediately in front of the sensitive plate. This arrangement is therefore particularly desirable where the nature of the photograph necessitates the shortest possible exposure.

A. Automatic Iris-Shutter.



Automatic Iris-shutter.

This shutter returns automatically after each exposure to its original position. It is therefore particularly adapted for rapid successive exposures and for interrupting and continuing time exposures at will. Its manipulation is simplicity itself.

The speed of the shutter is **not** adjustable mechanically. By appropriate pressure on the rubber ball the mechanism can, however, be set to work at any required speed from $^1/_{40}$ second upwards.

The shutter can be fitted with pneumatic release only.

The **larger sizes** of this shutter are particularly suitable for **studio** work.

Directions for use.

Adjustment of stop.	Milled-head *c*	to be set for required diamer of iris.
	Pin *d*	to be turned inwards until the shutter locks. Camera ready for focusing.
Instantaneous Exposures.	Pin *d*	to be completely screwed back.
	Milled-head *a*	to be set for required diameter of iris.
	Milled-head *c*	to be set to an aperture slightly larger than the preceding. According to the speed required apply either a sudden and firm, or a slowly continued pressure to the rubber ball.
Time Exposures.	Pin *d*	to be completely screwed back.
	Milled-head *c*	to be set for required diameter of iris.
	Milled-head *a*	to be set to an aperture at least two divisions larger than the preceding. Pressure on the rubber ball causes the iris to open; it closes again immediately the pressure ceases.

It is important to screw d out until it stops, otherwise the iris remains open, thus spoiling the plate.

B. Adjustable Iris-Shutter, Model 1899.

German Patent No. 101691.

This **adjustable Iris-Shutter** differs from our older design in several essential points. The shutter is now more compact, it is simpler to handle, and all the moving parts of the mechanism are protected by a casing. The new model will therefore prove more reliable in its action than the old shutter, whilst yet retaining all its old manysidedness of application. These advantages have been secured, not merely by a new mechanism, but also by the adoption of an entirely new form of shutter-iris. Whereas in the old iris-diaphragm all the leaves composing it lie one above the other and consequently occupy a comparatively large space between the lenses, the whole of the leaves of the new shutter are arranged in two tangential planes, and hence only a small space is required for their movement. By this means it is possible to place all the edges of the leaves in one plane, i. e., the opening of the iris is formed by lines which all lie in one plane, in consequence of which the opening of the iris does not vary with the obliquity of the rays. The leaves are made of steel.

The aperture of the iris-shutter is adjustable and can be used as the lens stop proper.

The speed of the new adjustable shutter can be varied mechanically within a margin of from $^1/_{150}$ to about 2 seconds. Beyond this period the apparatus can be set for "time" exposures of any duration.

All parts of the shutter are made of absolutely solid material so as to ensure reliable action. Only sparing use has therefore been made of aluminium. The new shutter possesses every element of durability and requires merely ordinary care. We shall always be ready to carry out, in a reliable and inexpensive manner, any repairs that may be necessary. To entrust the shutter to **other mechanicians** for repair might possibly be fatal to its mechanism, hence we would utter a **word of warning** against such practice.

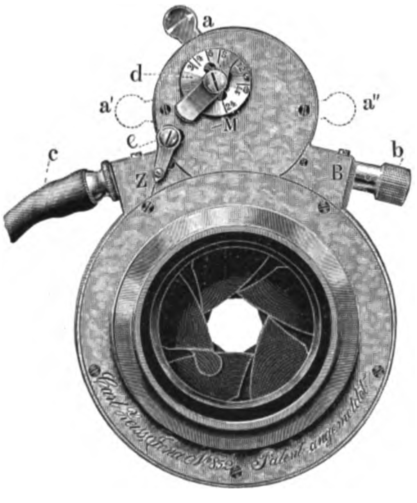
Applicability of the shutter. The new shutter is adapted for all kinds of photography, it may be used with any camera, in the studio as well as outdoors, and, being of a compact form, it is adapted even for the larger forms of hand cameras employing plates 9 × 12 cm ($3^1/_2 \times 4^3/_4$ in.) and upwards. But in those cases where it is absolutely necessary that the exposure should be less than $^1/_{150}$ second — for objects in very rapid motion — it is advisable to use focal plane shutters.

Directions for using the adjustable Iris-Shutter, Model 1899.

Adjustment of the shutter for any desired iris-opening. The opening of the iris is varied by means of index *d* and the dial indicates its diameter in millimetres. The iris can be set for any of the positions marked in millimetres as well as any intermediate divisions, whatever the position of the other parts may be. (The choice of the diameter of the opening depends upon the focal length of the objective, the nature of the photograph and the circumstances under which it is taken.)

Winding and releasing the shutter. The shutter is wound by means of the lever *a* by turning it from its position of rest *a′* into the notch at *a″*. It is released by pressing the pneumatic ball or, if the india rubber tube be detached, by pressing down the pin at *c* with the finger. It may also be released by pressing down index *e*. The latter should therefore, **before** winding, always be placed into the requisite position — *Z* for time, *M* for instantaneous exposure. **The iris does not open while the shutter is being wound.**

Mechanical adjustment of the speed of the shutter. The speed of the shutter is regulated, by means of the brake *B* (*b*), within the limits of $^1/_{150}$ and 2 seconds, the index *e* pointing towards *M*. The shutter works at its maximum speed of $^1/_{150}$ second when the brake index points to 0, and its slowest speed of about 2 seconds and longer is reached when the index is opposite 6. Intermediate positions furnish intermediate exposures. Exact data cannot be supplied as the action of the brake not only varies in different specimens, but also undergoes changes in course of time in consequence of regular use and under the influence of variations of temperature.



Adjustable Iris-Shutter, Model 1899.

Adjustment of stop.

Index *d*	to be set for required diameter of iris.
Index *e*	to be set to *Z*.
Lever *a*	to be moved towards and locked at *a″*.
Brake *B* (*b*)	to be set for 3 or 4.
Release action *c*	to be put in operation.

Camera ready for focusing.

Instantaneous Exposures.

Index *d*	to be set for required diameter of iris.
Index *e*	to be set to *M*.
Lever *a*	to be moved towards and locked at *a″*.
Brake *B* (*b*)	to be set according to desired rapidity of exposure.

Shutter ready for releasing at *c*.

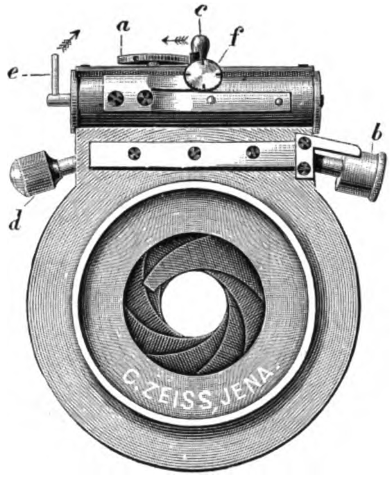
Time Exposures.

Index *d*	to be set for required diameter of iris.
Index *e*	to be set to *Z*.
Lever *a*	to be moved towards and locked at *a″*.
Brake *B* (*b*)	to be set for 3 or 4.

Shutter ready for releasing at *c*.

Index e should alwoys point accurately to Z or M, otherwise the shutter does not work and, in addition, certain parts of the mechanism are liable to be injured during the winding of the shutter.

C. Detective Iris-Shutter.



The Detective Iris-Shutter is designed for small hand-cameras. Particular care has accordingly been taken to make it as small and handy as possible, consistent with applicability to a great variety of purposes. The shutter is mechanically adjustable within sufficiently wide limits for instantaneous work (extending from about $^1/_{20}$ to $^1/_{60}$ second). Time exposures may be varied at will from $^1/_{20}$ second to any longer duration.

This shutter must be released by hand, the provision of pneumatic action being impracticable.

Directions for use.

Adjustment of stop.	Milled-head *b*	to be set for required diameter of iris.
	Pin *d*	to be turned forward until the shutter locks.
		Camera ready for focusing.
Instantaneous Exposure.	Pin *d*	to be screwed out until it stops.
	Milled-head *a*	to be set to the aperture required.
	Milled-head *b*	to be set to an aperture slightly larger than the preceding.
	Brake *f*	to be set to the required speed.
		(The 0 mark refers to the shortest possible exposure.)
	Bolt *c*	to be pushed towards *e* as far as it will go, when, by turning.
	Pin *e*	in the direction of the arrow, the mechanism is released.
Time Exposures.	Pin *d*	to be screwed out until it stops.
	Milled-head *b*	to be set to the aperture required.
	Milled-head *a*	to be set to an aperture two divisions larger than the preceding.
	Brake *f*	to be set to division 1 or 2.
	Bolt *c*	to be pushed towards *e* as far as it will go, when, by turning
	Pin *e*,	the iris is opened at the first, and closed again at the second operation of the mechanism.

It is important to screw d out until it stops otherwise the iris remains open, thus spoiling the plate.

Carl Zeiss, Optische Werkstaette, Jena.

Prices of the Iris-Shutters

incl. adaptation to objectives of our own make.

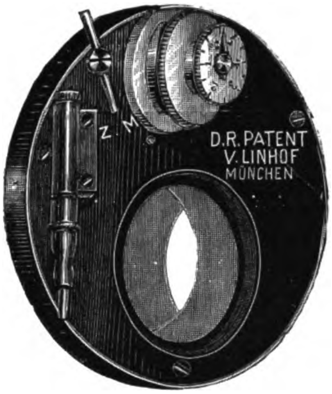
No.	A Automatic Iris-Shutter			B Adjustable Iris-Shutter Model 1899				C Detective-Iris-Shutter			Adapted for Objectives in Standard Mount*)
	Code-word	Price $	Diameter of Iris opening mm	Code-word	Price $	Diameter of Iris opening mm	External diameter of Iris casing mm	Code-word	Price $	Diameter of Iris opening mm	No.
1	**Ubi**	15.50	17	**Regatta**	35.—	20	60	**Zambo**	14.—	17	II
2	**Ulema**	17.50	27	**Regiment**	36.50	28	67.5	**Zebra**	15.50	27	With shutters A & C III—VI B III—IV
3	—	—	—	**Regine**	38.50	33	80	—	—	—	V, VI
4	**Ultra**	19.50	42	**Regis**	40.—	42	98	—	—	—	VII—IX
5	**Uranus**	21.—	53	—	—	—	—	—	—	—	X, XI
6	**Utopie**	23.—	62	—	—	—	—	—	—	—	XII

*) A list of Standard Mounts and the Lenses fitting them will be found on page 13.

For the adaptation of shutters to existing objectives it is absolutely necessary that the latter should be forwarded to our Works. For adaptations to objectives of other makers we make an extra charge of from 3.50 to 5.50 $.

Linhof's adjustable Leaf-Shutter.

We recommend the **Leaf-Shutter made by Mr. Valentin Linhof, of Munich,** in all cases in which it is either undesirable or impracticable to have the shutter fitted between the lenses and where it becomes necessary therefore to place it in front of the objective.



Linhof's Shutter No. IV.
($^{1}/_{2}$ Full Size.)

The shutter, as shown in the accompanying illustration, possesses the following advantageous features: It is capable of working at high speed (from $^{1}/_{100}$ to $^{1}/_{150}$ second), its speed can be regulated with ease and a fair degree of certainty of action, it works without vibration, it is handy and light. **The shutter does not open while being wound up.**

Directions for use.

Regulation of Speed. The greatest speed is obtained by setting the brake-head to 0; the intermediate divisions (1, 2, 3 &c.) give corresponding exposures of longer duration, and the longest exposure results when the brake-head is set to 5.

Instantaneous Exposure. Previous to winding place the pointer situated on the left of the spring casing against the letter *M* and set the brake-head to the division corresponding to the desired exposure. Then give the spring casing about $^{1}/_{3}$ turn, by the key (not seen in the illustration) attached to it, till the pawl catches into the ratchet wheel for the second time. The shutter is now set ready for exposure and may be released either by a **steady** pressure on the rubber ball or with the finger. In the latter case the tube should be detached and the brass pin of the release action pressed back.

Time Exposure. Turn the index on the left of the spring casing to the *Z* mark, place the brake-head against 2 or 3, and **lastly** wind the shutter by means of the key as before. The mechanism is released by a **brisk** pressure on the rubber ball, thereby causing the shutter to open and the exposure to commence. At the expiration of the desired period of exposure the ball is pressed a second time — or the brass pin may be depressed for the same purpose —, when the closing of the shutter terminates the exposure.

Shutters made by Valentin Linhof, of Munich.

No.	Shutter made in						Diameter of		Total Diameter of the Shutter	Careful Adaptation			
	Brass			Aluminium			Adapters kept in stock	Opening of Shutter		Shutter to slip on lens mount		Shutter between lenses of objectives	
	Code-word	Price	Approximate weight	Code-word	Price	Approximate weight				Standard Mount*)	Price	Standard Mount*)	Price †) incl. Iris
		$	gram		$	gram	mm	mm	mm		$		$
1	**Lias**	**13.50**	145	**Liguster**	**14.50**	85	36	25	68	I, II	**1.50**	II, III	**7.—**
2	**Libussa**	**13.50**	180	**Lilie**	**14.50**	100	46	33	80	III, IV	**1.50**	IV	**9.—**
3	**Libertas**	**14.50**	210	**Lilith**	**15.50**	120	56	39	92	V, VI	**2.—**	V—VIII	**10.50**
4	**Libra**	**14.50**	240	**Limax**	**15.50**	150	65	45	104	VII, VIII	**2.—**	—	—
5	**Lido**	**17.—**	300	**Linarit**	**18.—**	180	75	52	112	—	—	IX—X	**12.—**
6	**Liga**	**17.—**	410	**Lipsia**	**18.—**	210	80	60	130	IX, X	**2.—**	XI, XII	**14.—**
7	—	—	—	**Liquid**	**21.—**	400	—	70	155	XI, XII	**2.50**	—	—

*) For list of Standard Mounts and Objectives fitted in them see p. 13.

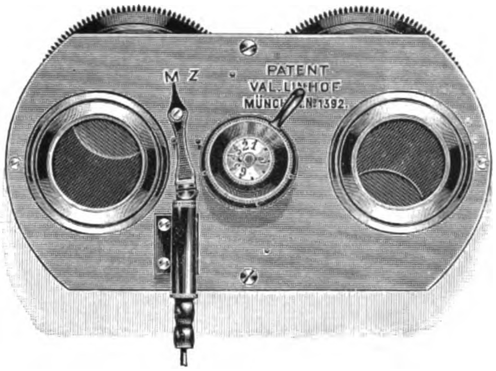
†) For shutters working between the lenses of a double objective we use those made of brass exclusively. They are, for this purpose, fitted with an **Iris-diaphragm** and **two very accurately centred tubular adapters.** If the adaptation is to be made to existing objectives, it is absolutely necessary that they should be forwarded to us. On account of the short distance this shutter cannot be adapted between the lenses with Series I^a, Nos. 1—11, and Series III^a, Nos. 0—2. In telegraphic orders it is sufficient to quote the code-word with the addition of the word "**Iris**".

Linhof's adjustable Stereoscopic Shutter.

The Stereoscopic Shutter acts in precisely the same manner as the Leaf Shutter just described. The directions given on the preceding page therefore apply equally in this case.

These shutters are made of aluminium only and are fitted with wheel-diaphragms placed in the plane of the stops.

The two wheel-diaphragms are in this case connected by teeth so that both stops may be adjusted simultaneously.



Linhof's Stereoscopic Shutter.
($^1/_2$ Full Size.)

The shutters of this description stocked by us place the lenses at a distance between centres of 85 mm ($3^3/_8$ in.). We are, however, prepared to supply, at short notice and at special rates, shutters allowing distances between lenses ranging between 80 and 100 mm ($3^1/_8$ to 4 in.).

Price of Linhof Stereoscopic Shutter made of aluminium and having a distance between the lenses of 85 mm ($3^3/_8$ in.) $ 24.50 **Lisko.**

Dimensions of shutter 13.5 × 7.6 cm ($5^3/_8$ × 3 in.).
Diameter of openings 23 mm ($^7/_8$ in.).
Weight about 200 gr. (7 ozs.).
Cost of adaptation for the stereoscopic pair . . . . $ 9.—

As an exception the Stereoscopic Shutters may be made to slip on the lens front, in which case they are supplied without wheel-diaphragm, the price, including cost of adaptation, being . . . . $ 23.— **Livia.**

When the objective is to screw on to the shutter, 2.— $ is to be added to above price, making . . . . . $ 24.50 **Livonia.**

We are prepared to supply, ***to order*** *and at* ***special rates,*** *and fit to* ***our*** *lenses, any other form of shutter which lends itself to adaptation.*

Complaints.

Our methods of manufacture and our rigorous system of tests are such as to almost entirely exclude complaints. Nevertheless, any complaints will have our best attention, since we are well aware that errors are possible even in the best regulated establishment. On the other hand, in cases where complaints prove obviously and utterly unfounded, we reserve to ourselves the right of charging for the time lost and expenses incurred in investigating them.

* * *

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